6185-1mc

T.O. 12R2-4-6-32

TECHNICAL MANUAL

FIELD MAINTENANCE

RADIO SET

618S-1/MC

(RADIO CORPORATION OF AMERICA)

AF33(604)-37030

Basic And All Changes Have Been Merged To Make This A Complete Publication.

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INTRODUCTION

This publication is prepared for use by organizational and field maintenance personnel as an aid in understanding and performing installation, maintenance, and service procedures for Radio Set 618S-1/MC. Repair, replacement, adjustment, and recalibration data for the radio set is limited to that capable of being performed by organizational and field maintenance activities using common tools, test equipment, and spare parts authorized in allowance lists and those specialized tools and test equipment listed in Section III of this manual. The manual is compiled and printed in accordance with Specifications MIL-H-25095 (USAF) and MIL-H-5474C and conforms to applicable portions of the following specifications:

MIL-STD-12B	Abbreviations for use on Drawings and in Technical Type Publications
MIL-STD-15	Electrical and Electronic Symbols
MIL-STD-16	Electrical and Electronic Reference Designations
MIL-STD-122	Color Code for Chassis Wiring for Electronic Equipment

ALL PHRASES OR STATEMENTS CONTAINED IN THIS MANUAL WHICH TEND TO LIMIT OR RESTRICT REPAIR ARE TO BE DISREGARDED. VALID BASE REPAIR RESTRICTIONS ARE CONTAINED IN SECTION VIII OF THE APPROPRIATE AIRCRAFT -6 INSPECTION MANUAL.

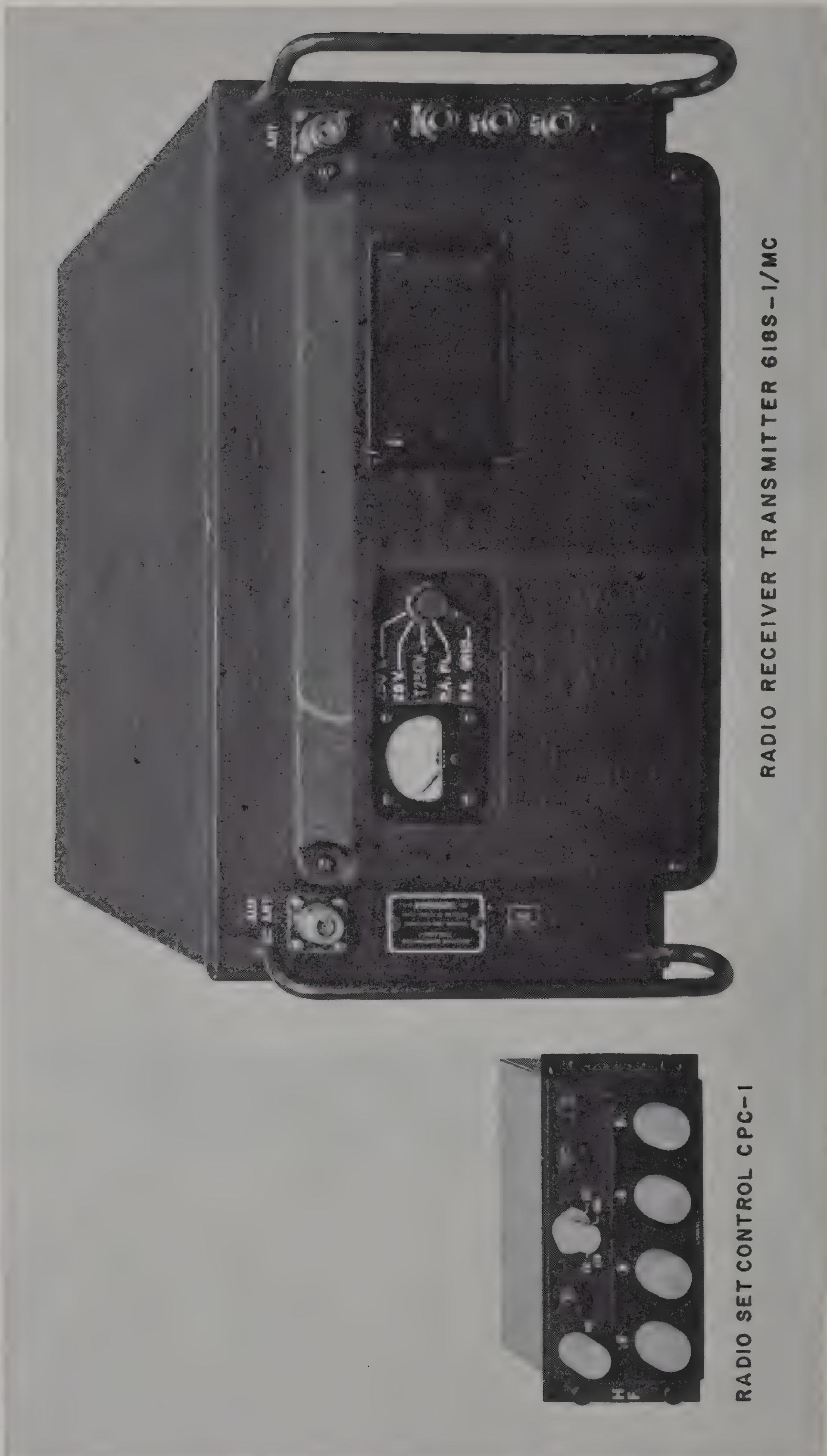


Figure 1-1. Radio Set 618S-1/MC

SECTION I
DESCRIPTION AND LEADING PARTICULARS

1–1. SCOPE OF MANUAL.

1–2. This publication comprises service instructions for Radio Set 618S–1/MC (hereafter referred to as the radio set) manufactured and supplied under Contract AF 33(604)–37030. Sections I through VI contain descriptive matter, preparation for use and reshipment, test equipment and special tool requirements, system operational theory, and check-out or analysis of the complete system. Sections VII through IX contain maintenance and circuit analysis for each of the components of the radio set. While this equipment is normally used with Automatic Antenna Tuner 180L-3 (hereafter referred to as the antenna tuner), this manual contains only references to the antenna tuner.

1–3. PURPOSE OF EQUIPMENT.

1–4. Radio Set 618S–1/MC is designed to provide transmitting and receiving facilities between aircraft and ground stations, or between aircraft within an operating frequency range of 2 to 25 megacycles. Three modes of operation are provided, radiotelegraph (A–1), radiotelephone (A–3), and single sideband (SSB) suppressed carrier radiotelephone signals. Provision is also made for adaption to radio teletype (fsk) operation when transmitting or receiving in the single sideband mode. The mode of operation and desired output frequency are selected by the operator at the Radio Set Control CPC–1 (hereafter referred to as the radio set control).

1–5. EQUIPMENT SUPPLIED.

1–6. Equipment supplied with Radio Set 618S–1/MC is illustrated in figure 1–1 and listed in the table of figure 1–2.

1–7. EQUIPMENT REQUIRED BUT NOT SUPPLIED.

1–8. Figure 1–3 lists the equipment required for operation but not supplied as part of the radio set. When installed in the aircraft, the equipment will be connected to and used with auxiliary equipment generally similar to that listed in the table.

1–9. PRINCIPLES OF OPERATION.

1–10. Radio Set 618S–1/MC is a remotely controlled transmitting and receiving system with all necessary control and mounting equipment supplied. Radio Receiver-Transmitter 618S–1/MC (hereafter referred to as the receiver-transmitter) is the major component in the system. All control of the receiver-transmitter is provided by the Radio Set Control CPC–1. Any frequency within the range of 2 to 25 megacycles and the mode of operation can be selected at the radio set control. When a new frequency is selected at the radio set control, automatic channeling circuits in the receiver-transmitter are actuated to tune the equipment to the desired frequency. Frequency selection at the radio set control also energizes the tuning circuits in the antenna tuner which operates to correctly match

Quantity Per Equipment	Name of Unit	AN Type Designation	Overall Dimensions (inches)			Weight (lbs)	Numerical Series Of Reference Symbols
			Length	Width	Height		
1	Radio Receiver-Transmitter	618S–1/MC	23–7/16	15–7/16	7–25/32	55.0	100 through 3699
1*	Mounting	350S–1	25–3/16	16–3/8	6–13/16	9.0	
1*	Mounting	350S–3	25–3/16	16–3/8	6–13/16	9.0	
1	Power Supply	416W–1	18–1/16	4–7/8	6–3/4	22.0	1600–1699
1	Mounting	350T–1	17–9/16	5–7/8	3–15/16	4.0	
1	Radio Set Control	CPC–1	4–9/16	5–3/4	2–19/32	1.75	3800–3899

* Alternate components in a normal installation.

Figure 1–2. Equipment Supplied, Radio Set 618S–1/MC

Quantity Per Equipment	Name of Unit	AN Type Designation	Required Characteristics
1	Automatic Antenna Tuner	180L–3	Provides automatic matching and loading of antenna.
1	Mounting	350D–3	Provides mounting facilities for the antenna tuner.
1	Primary D-C Power Source		See figure 1–11.
1	Primary A-C Power Source		See figure 1–11.
1	Antenna	Typical long wire.	Fixed wire, 45 to 100 feet long.
1	R-F Cable between J110 of 180L–2/3 and J101 of 618S–1/MC (W1).	RG–8/U	Coaxial cable (see figure 2–1).
1	R-F Cable between J103 of 180L–2 and J109 of 618S–1/MC (W2).	RG–58/U	Coaxial cable (see figure 2–1).
1	Cable between J102 of 180L–2/3 and TB1801 of 618S–1/MC (W3).		Cable to be fabricated from stock. See figures 2–1 and 3–5 and refer to paragraph 3–7.
1	Cable between J1601 of 416W–1 and TB1801 of 618S–1/MC (W4).		Same as preceding cable.
1	Cable between J3801 of CPC–1 and TB1801 of 618S–1/MC (W5).		Cable to be fabricated from stock. See figures 2–1 and 3–5 and refer to paragraph 3–7.
1	Cable between J1601 of 416W–1 and power source (W6).		Same as preceding cable.
1	Connector, P110	UG–21B/U	See figure 3–6 for assembly instructions.
1	Connector, P109	UG–88/U	See figure 3–7 for assembly instructions.
1	Connector, P102	UG–201/U	See T.O. 31R2–4–38–1.
1	Headset	H–1/AR or H–4/AR	300 ohms internal impedance.
1	Microphone	ANB–M–C1 or equal	Hand-held microphone with push-to-talk button.
1	Interphone amplifier	AN/AIC–4 or equal	
1	Signal Data Converter	CV–1053	Provides Fsk conversion.

Figure 1–3. Equipment Required But Not Supplied

the 52-ohm input impedance of the receiver-transmitter to the aircraft antenna for the frequency selected. Selection of the mode of operation is controlled by means of relay switching circuits in the receiver-transmitter.

1–11. Basic frequencies are generated within the receiver-transmitter by means of a continuously variable master oscillator controlled by a highly flexible, crystal controlled automatic tuning system. This tuning system maintains the radiated output signal to within ±50 cycles of the selected operating frequency. The output of the controlled master oscillator (cmo) is used to drive the r-f amplifier and multiplier circuits in the transmitter section and also to drive the low level frequency selection circuits in the automatic tuning system. Automatic tuning is accomplished in the r-f and power amplifier circuits by means of frequency discriminator and servo amplifier circuits. When the receiver section of the receiver-transmitter is being used, the output of the cmo is mixed with the incoming signal to provide the required difference i-f signal for amplification prior to demodulation of the signal.

1–12. Provision is made to transmit (in addition to cw) a single sideband, suppressed carrier signal or an equivalent AM. (ame) signal. The latter is accomplished by radiating the carrier at approximately one-half amplitude together with the single sideband modulation at one-half amplitude. This type of signal can be received on a conventional AM. receiver. When transmitting in the single sideband mode, the carrier is suppressed and only the upper sideband carries the modulation. In this mode full modulation is used. When operating as a receiver, a conventional tube diode circuit is used for AM. detection and the carrier

is reinserted in a separate product detector tube for demodulation when receiving in the single sideband mode.

1-13. All a-c and d-c power requirements are provided by Power Supply 416W-1 (hereafter referred to as the power supply). This power supply is designed to operate from the standard 27.5-volt d-c and 115-volt a-c, 400 cps power sources in the aircraft. Overload protection is afforded with fuses and circuit breakers located on the front panel of the power supply.

1-14. DESCRIPTION OF COMPONENTS.

1-15. RADIO RECEIVER-TRANSMITTER 618S-1/MC. Refer to figures 1-4 and 1-5. Unitized modular construction is used throughout the receiver-transmitter in order to simplify troubleshooting and maintenance procedures. The individual modules (hereafter referred to as subassemblies) plug into the main chassis and front panel. The entire unit is enclosed in a dust cover. The dust cover can be removed by rotating two Dzus fasteners located at the rear and pulling the chassis forward. With the chassis removed from the dust cover, the subassemblies (shown in figure 1-5) can be removed. Captive hold-down screws (painted red) retain the individual subassemblies in place. All electrical connections to the subassemblies are made through receptacles mounted on the main chassis. The connections to the power supply and the control panel are made through two connectors mounted on the rear of the main chassis. These connectors mate with jacks located on Mounting 350S-1/3 (see figure 1-6). Two wing nuts at the front of the mounting secure the receiver-transmitter to the mounting.

1-16. The front panel cover is secured by four screws and when removed, discloses the blower motor, sensitivity control, preset sidetone, and volume controls, and the positioning and tuning mechanism required for remote control of the equipment. Individual plug-in units which require mechanical linkage to each other or to the front panel are provided with quick disconnect, pintype or Oldham couplers to permit removal of the subassemblies from the main chassis. Once these linkages are synchronized, it is possible to remove and replace units without additional mechanical alinement. The blower draws air in through a filter and distributes the air to various parts of the equipment. The direction of air flow is determined by the positioning of holes in various portions of the chassis. Mounted on the front panel and accessible without removing the cover are: the "MIC, PHONE," and "KEY" jacks; the "ANT" and "AUX REC ANT"

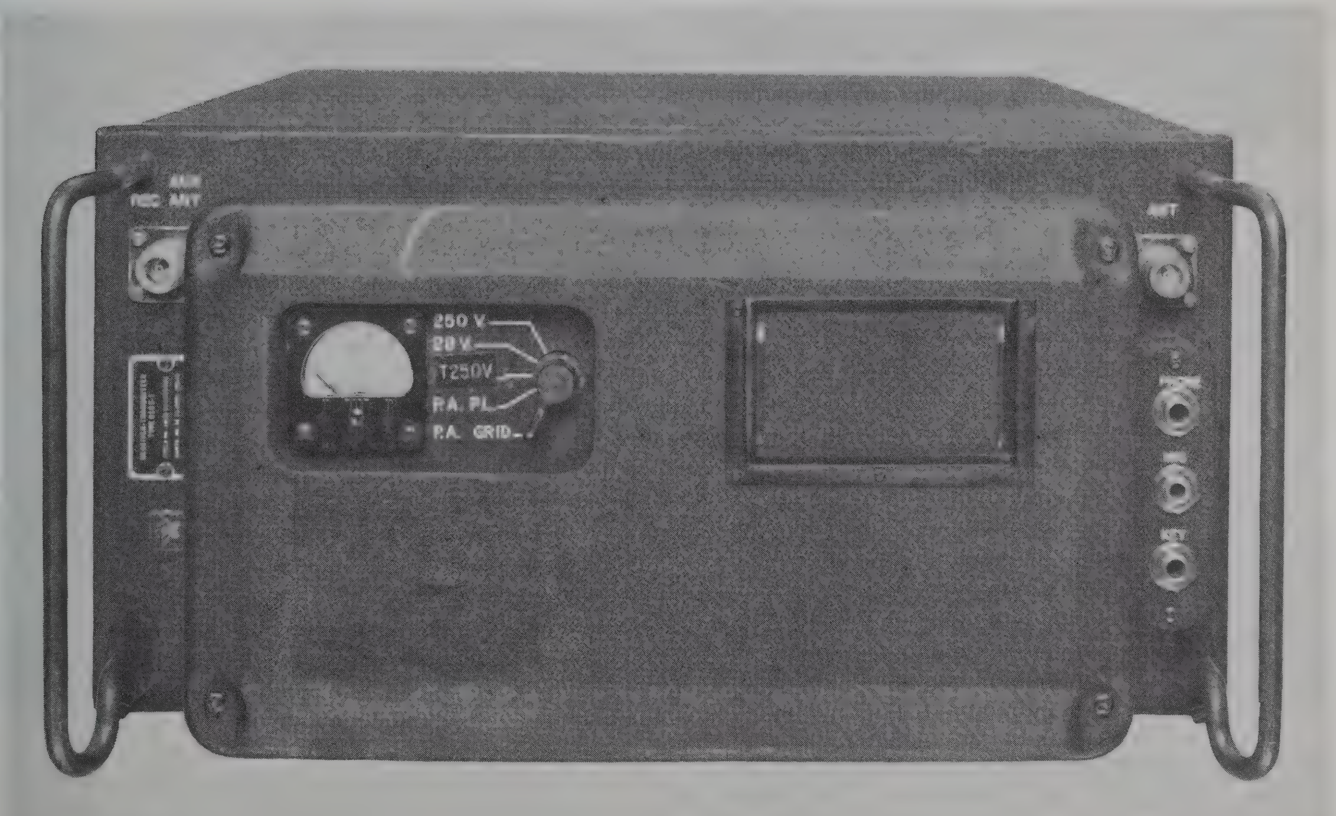


Figure 1-4. Receiver-Transmitter 618S-1/MC

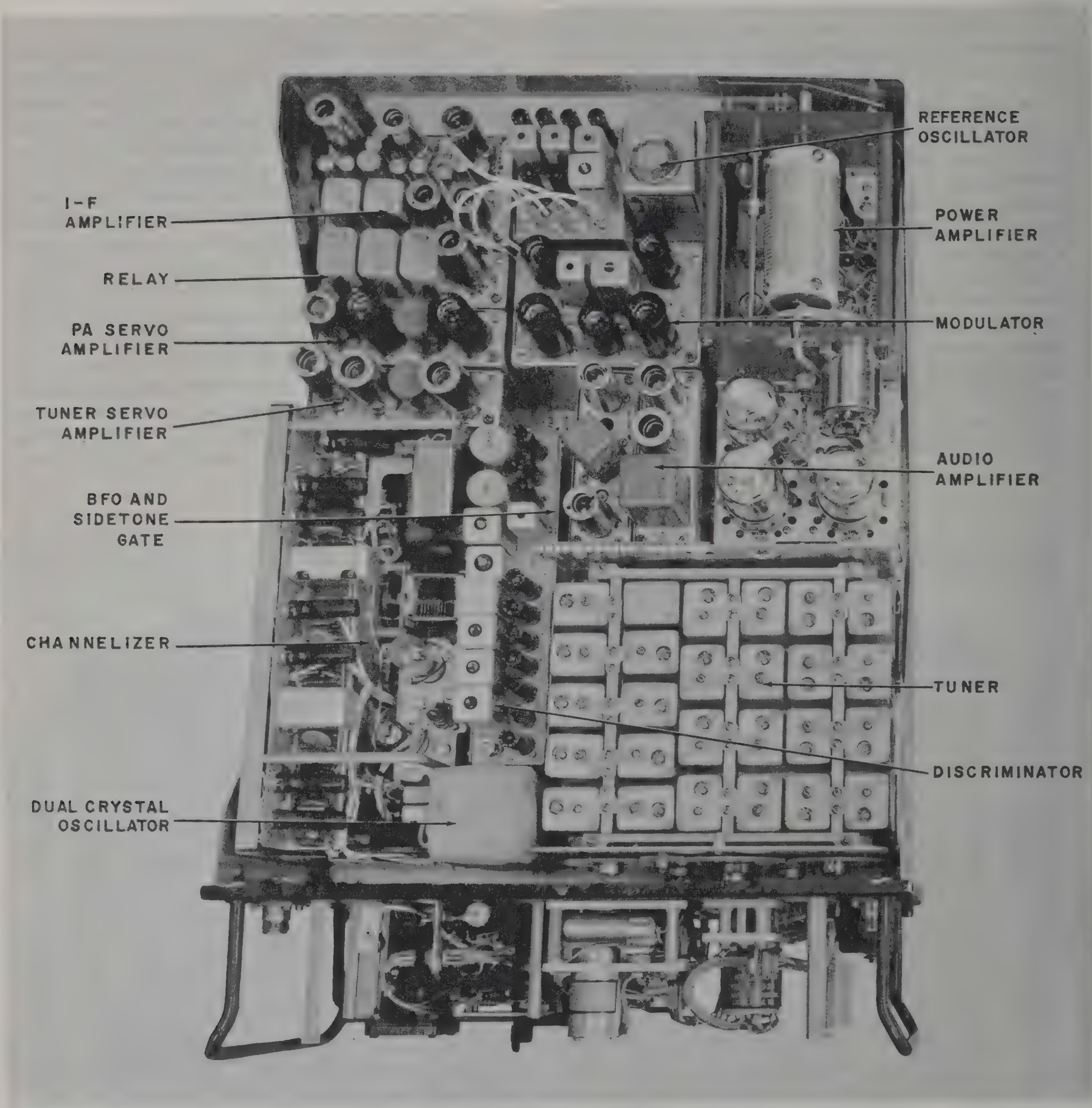


Figure 1-5. Receiver-Transmitter 618S-1/MC, Top View, Cover Removed

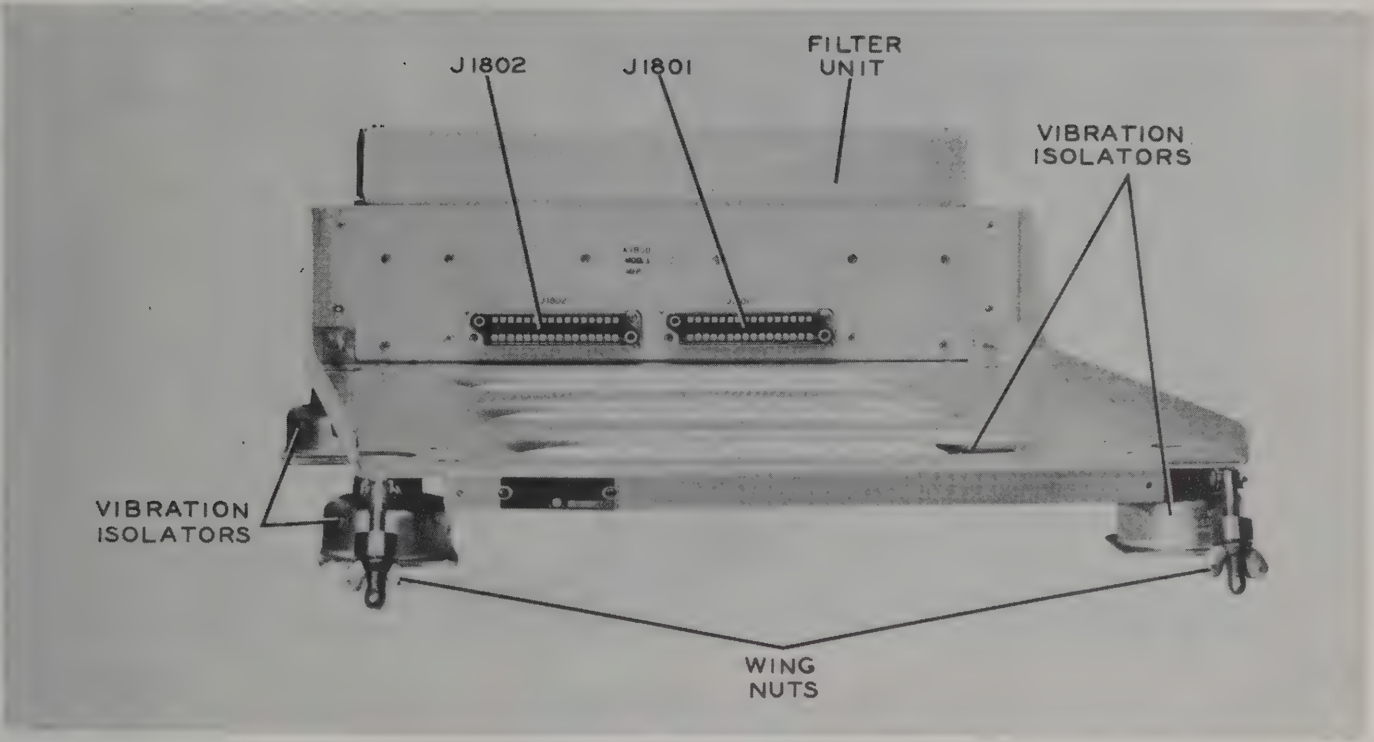


Figure 1-6. Mounting 350S-1 and 350S-3

terminals; and a meter and a meter switch labelled "250V, 28V, T250, P.A.PL" and "P.A. GRID."

1-17. MOUNTING 350S-1 AND 350S-3. Refer to figure 1-6. Both of these mountings are identical in appearance, weight, and mounting dimensions. The difference between the two units is in the method of removal of the filter unit. The filter unit of the 350S-3 is removable from both the front and top; whereas it is removable only from the top in the 350S-1. The 350S-3 is, therefore, the preferred mounting, since additional space is not required at the top of the receiver-transmitter for replacement of the filter unit. Vibration isolators and grounding straps are included on both mountings to assure vibration-free operation and good electrical contact.

1-18. POWER SUPPLY 416W-1 AND MOUNTING. The power supply shown in figure 1-7 consists of a main chassis, a dynamotor, front panel, and associated detail parts. The power supply provides 250 volts dc, 600 volts dc, 115 volts, 400 cps, 18 volts, 400 cps, 6.3 volts, 400 cps, negative 65 volts dc, and negative 50 volts dc. The two negative voltages and 18 volts ac are not used in this application. Two fuses and two circuit breaker switches are mounted on the front panel. The power supply is designed to mount on Mounting 350T-1 shown in figure 1-8.

1-19. RADIO SET CONTROL CPC-1. The radio set control shown in figure 1-9 is designed to provide complete remote operation of the receiver-transmitter. Provision is made for channel selection, control of volume, function selection, and tuning indication. A plastic front panel is included which is edge lighted by two lamps to provide illumination of the switches and controls.

1-20. OPERATING FUNCTION OF CONTROLS.

1-21. Figure 1-10 lists and explains the functions for the controls and connectors for each component of the radio set.

1-22. TECHNICAL SUMMARY.

1-23. Figure 1-11 is a technical summary of the radio set presented in tabular form.

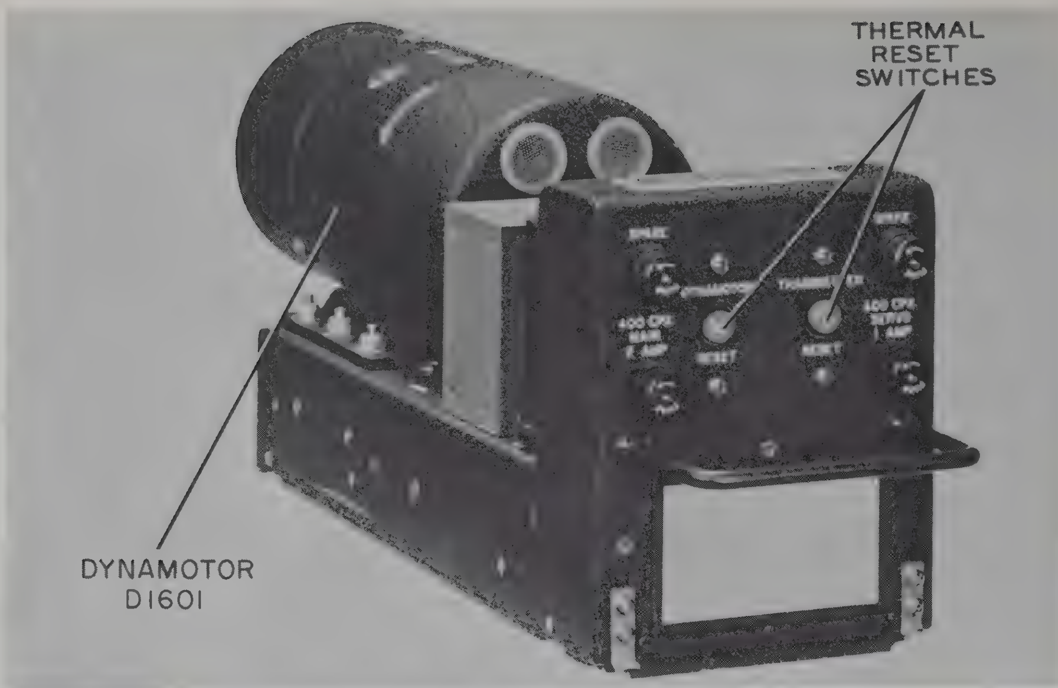


Figure 1–7. Power Supply 416W–1, Left Oblique View

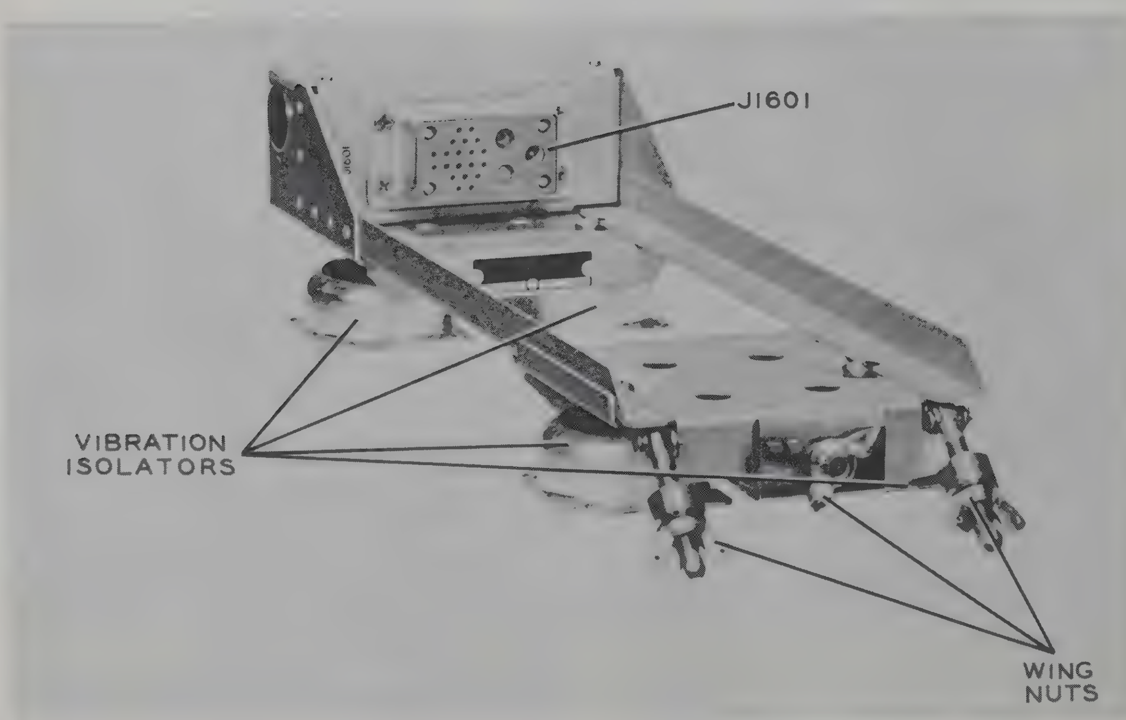


Figure 1–8. Mounting 350T–1, Left Oblique View

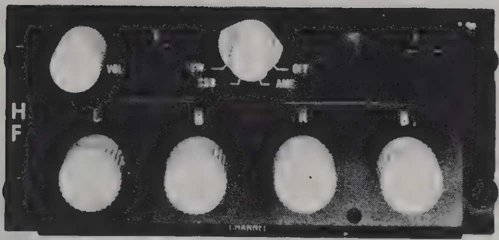


Figure 1–9. Radio Set Control CPC–1

1–24. FUSE COMPLEMENT: Two fuses are included with the 618S–1/MC system. Both are located on the front panel of Power Supply 416W–1 together with a spare for each. One protects the 320 to 1000 cps, 115-volt source and is rated at 2 amperes, 250 volts. The other protects the 115-volt, 380 to 420 cps source and is rated at 1 ampere at 500 volts.

1–25. TUBE AND SEMICONDUCTOR COMPLEMENT. Figure 1–12 is a tabular listing of the vacuum tubes, transistors, diodes, and indicator lamps used in the system. All listings are in accordance with numerical symbol sequence.

Name of Control	Function	Location
Radio Set Control CPC–1		
OFF-AME-SSB-CW	Controls application of power to equipment and controls mode of operation.	Front panel
VOL	Controls receiver audio level.	Front panel
CHANNEL		
(Thousands)	Controls selection of megacycle range when changing channels.	Front panel
(Hundreds)	Controls selection of hundreds of kilocycles when changing channels.	Front panel
(Tens)	Controls selection of tens of kilocycles when changing channels.	Front panel
(Units)	Controls selection of units and fractions of kilocycles when changing channels.	Front panel
Radio Receiver-Transmitter 618S–1/MC		
PHONE	Connection for headset.	Front panel
MIC	Connection for microphone.	Front panel
KEY	Connection for key.	Front panel
250V. –28V. –T250V. –P.A. PL. –P.A. GRID	Selects function of multiple use meter.	Front panel
ANT	Transmitter antenna jack.	Front panel
AUX REC ANT	Receiver antenna jack.	Front panel
Power Supply, 416W–1		
RESET	Manual reset for 27.5-volt d-c circuit breaker switches.	Front panel

Figure 1–10. Operating Function of Controls

a. Radio Receiver-Transmitter 618S-1/MC	
Frequency Range	2.0 to 25.0 megacycles in four bands.
Number of Channels	35,250
Frequency Interval	500 cps to 14.25 mc; 1kc above.
Frequency Stability	0.5 PPM, ±19 cps maximum deviation
Type of Frequency Control	Electronically controlled master oscillator.
Frequency change method	Auto-positioner type, remotely controlled automatic resonating of low level and servo mechanism control of tuning in the r-f amplifier circuits.
Channeling Time	8 seconds maximum, exclusive of antenna tuner.
Types of Emission	SSB: suppressed carrier telephony (upper sideband) AME: (modified AM. telephony) carrier plus one sideband (compatible AM) CW: (radiotelegraph)
Voltage Requirements	
D-C Supply Voltage	27.5 volts
A-C Supply Voltage	115 volts, 380–420 cps, single phase
Current Required at Specified Rated Voltage	
27.5 volts	Phone Receive Mode: 6.6 amperes Phone Transmit Mode: 26.0 amperes CW Receive Mode 6.6 amperes CW Transmit Mode: 19.8 amperes
115 volts, 380-420 cps	185.0 va.
Transmitter Section	
Power Output	90 watts, P.E.P. minimum from 2.0 to 14.2495 megacycles and 80 watts, P.E.P. minimum from 14.250 to 25.0 megacycles.
Antenna Tune Power	50 watts, approximately
Output Impedance	52 ohms
Antenna Matching	Capable of automatically tuning and loading antenna into 52-ohm transmission line terminated by the antenna tuner.
Altitude Range	Full power up to 50,000 feet
Modulation Capacity	100 percent at rated power output
Carrier Suppression	40 db, minimum
R.F. Carrier Distortion	−45 db (second harmonic −35 db)
Audio Input	100-ohm input from standard aircraft microphone at 0.25-volt, rms
Speech Clipping	Up to 15 db
Frequency Response	+1.5, −3.5 db from 300 to 3500 cps
Distortion	Less than 10 percent at 60 percent modulation
Sidetone	Voice signals from modulator coupled into receiver section audio stages for reproduction in headset. Coupling into audio stages accomplished by means of gating control circuit when operating in "AME" and "SSB" modes. Keyed 400-cps line voltage used for monitoring of cw transmissions.
Keying Break-in	Up to 30-words-per-minute using a common antenna for transmitting and receiving.
Receiver Section	
Sensitivity	AME: 3 microvolt maximum input for 6-db signal-plus-noise to noise ratio with standard test signal modulated 30 percent at 1000 cps. CW: 3 microvolt maximum input for 10-db signal-plus-noise to noise ratio. SSB: 1.5 microvolts for 10-db signal-plus-noise to noise ratio.
AVC	Maximum output variation of 3.5 db for signal input of 10 to 100,000 microvolts. No overload below 1-volt signal.

Figure 1–11. Technical Summary, Radio Receiver-Transmitter 618S–1/MC (Sheet 1 of 2)

a. Radio Receiver-Transmitter 618S-1/MC (cont)	
Selectivity	AME and CW: 5.5 kilocycles maximum at 6db down, 14 kilocycles minimum at 60db down. SSB: 3 kilocycle minimum at 6db down. 8 kilocycle maximum at 60db down.
I-F and Image Rejection	80 db minimum
Audio Power Output	100 milliwatt minimum into 300-ohm load
Audio Fidelity	300 to 3000 cps, ±6 db maximum
Distortion	10 percent, maximum
Noise Limiting	Series type, biased peak noise limiter.
CW Reception	Fixed bfo
b. Power Supply 416W-1	
Dynamotor Manufacturer	Windcharger Corp.
Dynamotor Type	4159
Dynamotor Catalogue	SS6012
Dynamotor Output	600-volts, d-c at 550 milliamperes; 250-volts, d-c at 150 milliamperes
Dynamotor Input	27.5-volts, d-c at 21.6 amperes, full load
Dynamotor Ambient Operating Temperature	−55°C (67°F) to +55°C (131°F)

Figure 1-11. Technical Summary, Radio Receiver-Transmitter 618S-1/MC (Sheet 2 of 2)

Designation	Type	Description	Location	Function
CR301	1N540	Rectifier diode	Main Chassis	−65-volt bias rectifier
CR302	USN1N3036B	Zener diode		Bias supply voltage regulator (−47V)
CR303	1N538	Rectifier diode		
CR304	1N538	Rectifier diode		
CR305	1N538	Rectifier diode		
V601 1	5751	Dual triode tube	Tuner Servo and PA Servo Amplifier Subassemblies	First and second servo amplifier tubes
V602 2	5686	Pentode tube		Servo amplifier output
V801 3	OA2WA	Gas diode tube	Relay Subassembly	+150-volt regulator
V901 4	5749	Pentode tube	I-F Amplifier Subassembly	First i-f amplifier
V902 5	5749	Pentode tube		Second i-f amplifier
V903 6	5749	Pentode tube		Third i-f amplifier
V904 7	5726	Dual diode tube		Detector (cw and ame modes) and avc rectifier.
V905 8	5726	Dual diode tube		AVC and noise limiter
CR901	1N458	Switching diode		SSB switching control

Figure 1-12. Tube and Semiconductor Complement, Radio Set 618S-1/MC (Sheet 1 of 4)

Designation	Type	Description	Location	Function
V1001	5654	Pentode tube	Tuner Subassembly	Tuner discriminator
V1002	5749	Pentode tube		Variable i-f amplifier
V1003	5750	Mixer tube		Second mixer, transmitter
V1004	5750	Mixer tube		First mixer, transmitter
V1005	5750	Mixer tube		First mixer, receiver
V1006	5750	Mixer tube		Second mixer, receiver
V1007	5654	Pentode tube		Frequency multiplier
V1008	5749	Pentode tube		First r-f amplifier
V1009	5749	Pentode tube		Second r-f amplifier
V1010	5686	Pentode tube		Driver amplifier
V1011	5686 19	Pentode tube		Driver amplifier
CR1001	1N198	Rectifier diode		P/O tuner discriminator
CR1002	1N198	Rectifier diode		P/O tuner discriminator
CR1003	1N198	Rectifier diode		P/O tuner discriminator
CR1004	1N198	Rectifier diode		P/O tuner discriminator
CR1005	1N198	Rectifier diode		P/O tuner discriminator
CR1006	1N198	Rectifier diode		P/O muting circuit
V1202	5749	Pentode tube	Sidestone Gate and BFO Subassembly	Beat frequency oscillator
V1203	6AU6WA 21	Pentode tube		
CR1201	1N137A	Rectifier diode		Sidetone gate control
V1301	5814	Dual triode tube	Audio Amplifier Subassembly	First and second audio amplifiers
V1302	5686	Pentode tube		Output amplifier
V1401	5751	Dual triode tube	Modulator Subassembly	Input amplifier and cathode follower
V1402	5726	Dual diode tube		Speech clipper
V1406	5726	Dual diode tube		Balanced modulator
V1407	5751	Dual triode tube		SSB and AME carrier insert control
V1408	6AU6WA 28	Pentode tube		CW, AME, and SSB amplifier
CR1401	1N457	Rectifier diode		Carrier switching
CR1402	USN1N970B	Zener diode		AME carrier gate bias voltage regulator (+24V)
CR1403	1N457	Rectifier diode		AME carrier control bias rectifier
CR1404	1N457	Rectifier diode		AME carrier control bias rectifier
Q1401	2N404	Transistor		Audio amplifier
V1501	6159	Pentode tube	Power Amplifier Subassembly	Power amplifier
V1502	6159	Pentode tube		Power amplifier
V1503	6159	Pentode tube		Power amplifier

Figure 1-12. Tube and Semiconductor Complement, Radio Set 618S-1/MC (Sheet 2 of 4)

Designation	Type	Description	Location	Function
CR1501	1N198	Rectifier diode		P/O power amplifier discriminator
CR1502	1N198	Rectifier diode		P/O power amplifier discriminator
CR1503	1N198	Rectifier diode		Sidetone gate control bias
CR1601	Selenium	Rectifier stack	Power Supply 416W-1	+250-volt, d-c rectifier
CR1602	Selenium	Rectifier stack		—65-volt, d-c rectifier
CR1603	Selenium	Rectifier stack		+250-volt, d-c rectifier
V3301	5840	Pentode tube	Channelizer Subassembly	500-kc harmonic amplifier
V3302	5636	Pentode tube		Mixer
V3303	5636	Pentode tube		50-kc harmonic amplifier
V3304	5636	Pentode tube		Mixer
V3305	5636	Pentode tube		5-kc harmonic amplifier
V3306	5636	Pentode tube		Mixer
V3307	5840	Pentode tube		Controlled master oscillator
V3308	5840	Pentode tube		Buffer amplifier
V3309	0B2	Gas diode tube		Voltage regulator (+108V)
CR3301	1N457	Rectifier diode		
CR3302	1N457	Rectifier diode		
CR3303	1N457	Rectifier diode		
CR3304	1N457	Rectifier diode		
CR3305	1N457	Rectifier diode		
CR3306	1N457	Rectifier diode		
CR3307	1N457	Rectifier diode		
CR3308	1N457	Rectifier diode		
CR3309	V15	Varicap diode		Fine tuning control
CR3310	V15	Varicap diode		Fine tuning control
V3401	5840	Pentode tube	Discriminator Subassembly	Doubler-amplifier
V3402	5636	Pentode tube		Mixer
V3403	5636	Pentode tube		Divider-mixer
V3404	5840	Pentode tube		Tripler-amplifier
V3405	6021	Dual triode tube		Phase inverter and cathode follower
V3406	5636	Pentode tube		Mixer
V3407	6021	Dual triode tube		50-kc locked oscillator and cathode follower
V3408	6021	Dual triode tube		10-kc locked oscillator
V3409	6021	Dual triode tube		5-kc locked oscillator and cathode follower
V3410	5840 50	Pentode tube		Tuning control
CR3401	1N457	Rectifier diode		P/O difference detector
CR3402	1N457	Rectifier diode		P/O difference detector

Figure 1-12. Tube and Semiconductor Complement, Radio Set 618S-1/MC (Sheet 3 of 4)

Designation	Type	Description	Location	Function
CR3403	1N457	Rectifier diode		P/O difference detector
CR3404	1N457	Rectifier diode		P/O difference detector
CR3405	1N457	Rectifier diode		Varicap bias rectifier
V3501	6021	Dual triode tube	Reference Oscillator Subassembly	Buffer amplifier and 500-kc locked oscillator
V3502	6021	Dual triode tube		250-kc locked oscillator and buffer amplifier
V3503	5636	Pentode tube		SSB demodulator
V3504	6021	Dual triode tube		100-kc locked oscillator and saw-tooth generator
V3505	6021	Dual triode tube		Dual 500-kc cathode follower
V3506	6021	Dual triode tube		ALC bias amplifier and cathode follower
CR3501	1N457	Rectifier diode		ALC bias rectifier
CR3502	1N457	Rectifier diode		ALC bias rectifier
V3601	6021	Dual triode tube	Dual Crystal Oscillator Subassembly	200 to 200.75-kc and 330 to 339-kc oscillators
CR3601	V15	Varicap diode		Fine tuning control (330-339 kc)
CR3602	V15	Varicap diode		Fine tuning control (330-339 kc)
CR3603	V15	Varicap diode		Fine tuning control (200-200.75 kc)
CR3604	V15	Varicap diode		Fine tuning control (200-200.75 kc)
CR3605	USN1N3029B	Zener diode		Voltage Regulator (+24V)
I3801	AN3140–327	Indicator lamp	Radio Set Control CPC–1	Front panel illumination
I3802	AN3140–327	Indicator lamp		Front panel illumination
I3803	AN3140–327	Indicator lamp		Tuning Indication

Figure 1–12. Tube and Semiconductor Complement, Radio Set 618S–1/MC (Sheet 4 of 4)

SECTION II
PREPARATION FOR USE AND RESHIPMENT

2-1. UNPACKING AND INSPECTING THE EQUIPMENT.

2-2. The equipment should be handled and unpacked with extreme care. Inspect each unit for evidence of damage during shipment or missing parts. The received equipment should be checked against the packing slip and the list of equipment supplied, figure 1-2 of this manual. Carefully remove the equipment from the packing boxes. Save all internal packaging, filler, blocking, and bracing materials for re-use with the original packaging containers when the equipment is repacked for storage or shipment. Check the mechanical operation of the equipment by rotating the control knobs. All claims for damage in shipment must be filed promptly with the transportation company involved.

2-3. VISUAL INSPECTION.

2-4. RADIO RECEIVER-TRANSMITTER 618S-1/MC.

a. Rotate the two Dzus fasteners located at the rear of the component and pull the chassis from the cover.

b. Inspect all tubes for proper seating in their sockets and check the tube shields for mechanical security.

c. Inspect the redheaded captive screws of each subassembly for tightness.

d. Inspect mechanical parts such as gears and rollers for evidence of damage.

e. Remove the front panel cover by removing the four retaining screws.

f. Inspect the main chassis and front panel mounted parts for dirt, metal scraps, or condensation.

g. Inspect the roller coil (E1513) and adjust if necessary.

h. Deleted

i. Replace the front panel cover and the main chassis cover.

2-5. POWER SUPPLY 416W-1.

a. Remove the bottom plate from Power Supply 416W-1. The bottom plate is secured by four screws.

b. Inspect for loose or broken parts, dirt, metal scraps, and condensation.

c. Operate all controls and check mechanical operation.

d. Replace the cover.

2-6. PREINSTALLATION BENCH CHECK.

2-7. A test bench cabled to accommodate the components to be tested, and the various test instruments, should be provided. The cabling between components should simulate that of an actual aircraft and should be in accordance with figures 2-1 and 3-5. Jacks should be included in the bench wiring for connecting the microphone and headset when needed. For aural monitoring, the monitor (item 22 of figure 3-1) may be connected to terminal b of P2601/J2601. If connected to the "PHONE" jack, the volume is not variable. The power source should be connected into the test bench wiring and must be protected by suitable fuses or circuit breakers.

2-8. CONNECTIONS. Connect all components to be tested to the test bench harness. A typical bench test setup for the system is illustrated in figure 2-2. Perform the following operations:

a. Connect Bird Model 82 Dummy Load and VTVM TS-375/U to E102 (test point 1) of the antenna tuner. If the antenna tuner is not used, the dummy load and vtvm should be connected to the "ANT" jack, J110 and a toggle switch connected between terminal 13 of TB1801 and ground. With the switch closed, the equipment is placed in low power tune operation for the tests. Set the TS-375/U to the 120 volt a-c range.

b. Connect Frequency Meter AN/USM-26 to a 1 megohm, 0.5 watt resistor, and connect the 1-megohm resistor to test point 2. Ground the ohter AN/USM-26 lead.

c. Connect Signal Generator AN/URM-25 between "AUX REC ANT" jack, J101 (test point 3) and ground.

d. Connect Output Meter TS-585B/U between "PHONE" jack, J101 (test point 4) and ground.

e. Connect the dummy microphone, Audio Oscillators TS-382/U, and VTVM TS-375/U, between "MIC" jack, J102 (test point 5) and ground as illustrated in figure 2-2.

f. Connect a telegraph key to "KEY" jack, J103 (test point 6).

g. Complete cabling to the components as illustrated in figure 2-1.

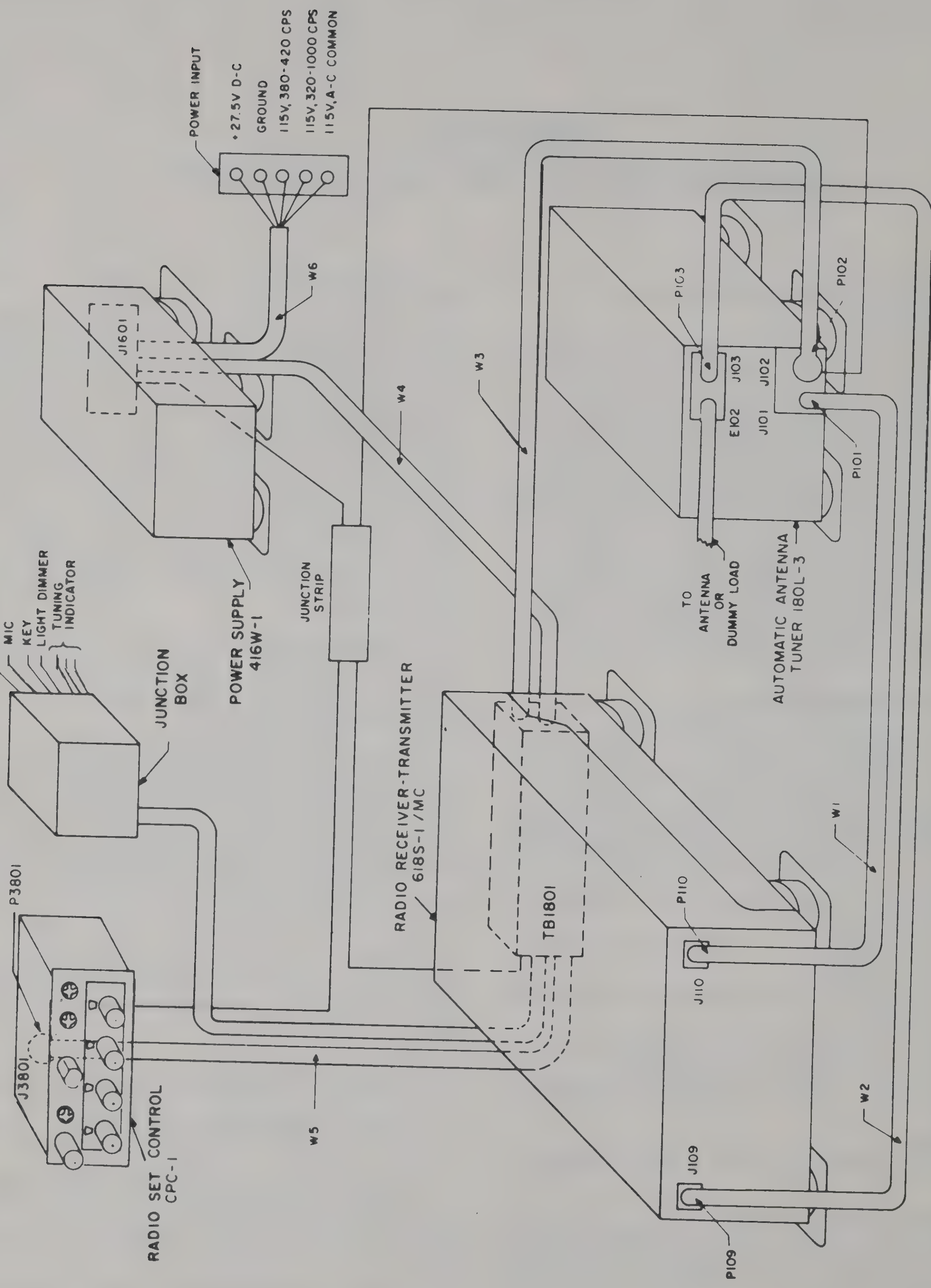


Figure 2–1. Radio Set 618S–1/MC System Interconnections

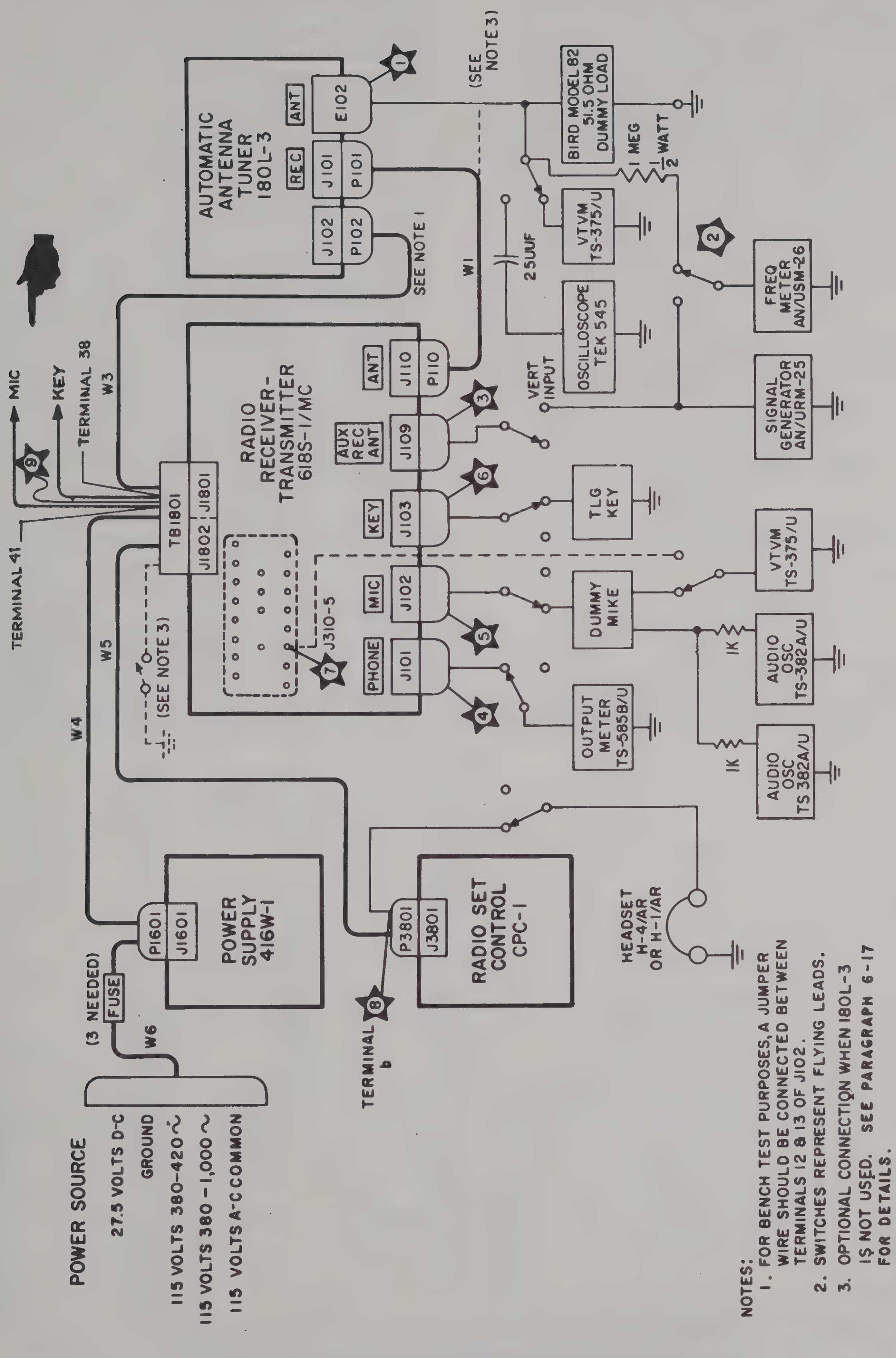


Figure 2–2. Bench Test Setup Showing Major Test Points

2–9. FREQUENCY SELECTION. Tuning of the equipment is accomplished by means of the four frequency determining switches on the Radio Set Control CPC–1. The thousands switch (first to the left), in addition to changing the megacycle digits, also selects the band of operation. The hundreds, tens, and units switches are used to select all frequencies below one megacycle. A letter of the alphabet is assigned to each position of each switch. Frequency selection is therefore accomplished by means of a letter code. In order to setup any desired operating frequency, it is necessary to convert the numerals in the frequency to the corresponding letter code. As noted in figure 2–3, letters are assigned to the switch settings that correspond to the frequencies controlled and selected by each switch. As all basic frequencies are generated in the controlled master oscillator, it is necessary to compute the cmo frequency before conversion to the letter code. The following formula shows how the cmo frequency can be derived from the operating frequency.

$$\text{cmo} = \frac{\text{Operating Frequency} - 250 \text{ kc}}{n}$$

As an example, if an operating frequency of 14,249.5 kc is desired, this frequency can be substituted in the equation to give

$$\text{cmo} = \frac{14{,}249.5 - 250}{4} = 3499.875$$

(The numerical divisor is obtained from the table of figure 2–3 and will depend upon the band of operation for any given operating frequency.) Choose the number in the thousands column which is immediately below the cmo frequency (3499.875) numerical value and having the correct divisor. In this case, 3400 with the divisor 4 is correct. Reading across to the left in the letter code column and on a line with 3400 is the letter to which the thousands switch is to be set ("T"). Subtracting 3400 from 3499.875 leaves the difference 99.875. Therefore choosing the next lowest (or in some cases the equivalent as outlined in the following paragraph) number in the hundreds column, in this case 50, and noting the corresponding letter, the hundreds switch is set to "C". The divisor is ignored when selecting the letter code for the hundreds, ten, and units switches. Subtracting 50 from 99.875 leaves 49.875. Selecting the combination of numbers in the tens and units columns which results in a total of 49.875 (45.25 and 4.625) gives the two remaining letters in the code. In this case, the tens and units switches must both be set to the letter "Z". The complete letter code for an operating frequency of 14,249.5 kc will therefore be, "TCZZ" reading from left to right in the channel select switch windows.

2–10. In some instances, the selected operating frequency will end in one or more zeros. This would be the case for an operating frequency of 2500 kc. Subtracting 250 from 2500 would give 2250. As 2250 kc is within the range of the basic frequencies generated by the cmo, the divisor is 1 and all operation will be in band 1. The next lowest number in the thousands column below 2250 will be 1900. This leaves a difference of 350 which is listed in the hundreds column. As the settings of the thousands and hundreds switches

Band	Divisor (n)	Switch Letters	Selector Switch Frequencies (KC) Thousands	Hundreds	Tens	Units
1 2000 kc to 3749.5 kc	1	B C D F G	1400 1900 2400 2900 3400	0 50 100 150 200	0 5.0 10.0 15.0 20.0	0 0.5 1.0 1.5 2.0
2 3750 kc to 7249.5 kc	2	H J K L M	1400 1900 2400 2900 3400	250 300 350 400 450	25.0 30.0 35.0 40.0 45.0	2.5 3.0 3.5 4.0 4.5
3 7250 kc to 14,249.5 kc	4	N P R S T	1400 1900 2400 2900 3400		0.250 5.250 10.250 15.250 20.250	0.125 0.625 1.125 1.625 2.125
4 14,250 kc to 25,000 kc	8	V W X Y Z	1400 1900 2400 2900		25.250 30.250 35.250 40.250 45.250	2.625 3.125 3.625 4.125 4.625

Figure 2–3. Operating Frequency vs. Letter Code Conversation

will result in the required 2250 kc frequency, the tens and units switches must both be set for zero frequency. Referring to figure 2-3 will show that the letter code "CKBB" setup on the channel selector switches will result in the desired operating frequency. Figure 2-4 lists the low and high frequency in each of the four bands along with the respective letter codes and their computation.

Note

A thermal switch is used in the channelizer subassembly electromechanical circuits to protect the motor. The thermal element in this switch will reach operating temperature and open the voltage source to the motor whenever the motor operates in excess of approximately sixty seconds. This switch will operate if ever a malfunction occurs in the tuning circuits or whenever excessive channeling is attempted. Therefore, it is recommended that a minimum period of one-minute be allowed to elapse immediately after selection of, and before changing to, a new frequency. If this precaution is not observed, the switch will operate to disable the motor circuit. Opening of the thermal switch contacts prevents operation of the equipment in both the receive and transmit modes. Therefore, normal receiver background noise and no sidetone will be heard in the headset. Whenever this occurs, it will be necessary to operate the function switch on Radio Set Control CPC-1 to its "OFF" position and allow a minimum cooling-off time of approximately one minute to elapse before reapplication of power to the equipment. After power is reapplied to the equipment, select a new frequency and make certain the tuning circuits are functioning normally before retuning the selected channel.

2-11. FREQUENCY SELECTION TESTS. Perform the following operations:

a. Press the "RESET" switches of Power Supply 416W-1 and operate the function switch on Radio Set Control CPC-1 to the "AME" position. Allow at least 10 minutes to elapse in order for the equipment to reach a normal operating temperature.

b. Operate the channel selector switches on the

Operating Frequency	Minus Carrier	Divide by (n)	CMO Frequency	Selector Switch Code			
				Thousands	Hundreds	Tens	Units
2000 kc	250	1	1750	B	K	B	B
3749.5 kc	250	1	3499.5	G	C	M	M
3750 kc	250	2	1750	H	K	B	B
7249.5 kc	250	2	3499.75	M	C	Z	M
7250 kc	250	4	1750	N	K	B	B
14,249.5 kc	250	4	3499.875	T	C	Z	Z
14,250 kc	250	8	1750	V	K	B	B
25,000 kc	250	8	3093.75	Y	F	Y	K

$$\text{CMO} = \frac{\text{Operating Frequency } -250}{n} \text{ or Operating Frequency } = n(\text{CMO}) +250$$

Figure 2-4. Letter Code For High and Low Frequency in Each Band

Band 1		Band 2		Band 3		Band 4	
Test Frequency	Switch Positions	Test Frequency	Switch Positions	Test Frequency	Switch Positions	Test Frequency	Switch Positions
2000	BKBB	3750	HKBB	7250	NKBB	14,250	VKBB
2255.5	CDCC	4572	JHDD	8344.5	PDGX	18,910	WLJH
2875	DGHB	5499.75	KGTZ	9118	PJFG	19,625	XBTS
3588	FLKJ	7249.5	MCZM	9749.5	PMTZ	25,000	YFYK
3749.5	GCMM			13,866	TBBL		
				14,249.5	TCZZ		

Figure 2-5. Frequency Selection Test Frequencies

radio set control to each of the positions listed in figure 2-5. Observe the output frequencies on Frequency Meter AN/USM-26 for each channel selected. Frequencies should not vary more than 0.5 parts per million ±19 cycles of those listed in figure 2-5.

c. Check the time interval required for the tuning cycle to complete when operated from the "BKBB" position to the "YFYK" position. Radio Receiver-Transmitter 618S-1/MC should complete its tuning cycle in eight seconds or less. The antenna tuner should complete its tuning cycle in 22 seconds or less.

Note

Do not attempt to change frequency more than once a minute. If channeled too frequently, a time delay relay (K711) in the antenna tuner will heat and prevent the equipment from completing its tuning cycle. Relay K711 will also operate if the total tuning time, following the centering cycle of the tuner subassembly exceeds 45 seconds. If relay K711 does operate, wait at least one minute before re-channeling the equipment.

2-12. TRANSMITTER TESTS.

2-13. CW POWER OUTPUT.

a. Connect the dummy load and the r-f probe of VTVM TS-375/U from test point 1 to ground. Remove the 1-megohm resistor and disconnect the Frequency Meter AN/USM-26.

b. Connect a telegraph key to test point 6 or a microphone to test point 5. All other test equipment should be disconnected.

c. Operate the function switch on the radio set control to the "CW" position.

d. Set the channel selector switches on the radio set control for an output frequency of 2.0 mc ("BKBB") and permit the equipment to complete its tuning cycle.

e. Depress the telegraph key or microphone push-button and observe the indication on the TS-375/U. The reading should not be less than 68 volts ac, which corresponds to 90 watts power output.

Note

The maximum duty cycle of this equipment is five minutes carrier-on. If kept on for this length of time, allow at least a five minute period in the carrier-off condition to permit the heat to be dissipated, and the equipment to return to normal operating temperature. In order to assure reliable operation, never exceed this duty cycle.

f. Operate the meter selector to the "P.A. PL" position and observe indication. Meter should indicate within the red area.

g. Repeat steps e and f for all positions and bands listed in figure 2-4. In each case the TS-375/U should give a minimum reading of 68 volts ac for frequencies of 14.2495 MC and below 64 volts ac (80 watts) for frequencies above 14,250 MC and above.

2-14. SSB/FSK OUTPUT POWER.

a. Connect the dummy microphone circuit to test point 5.

b. Connect the TS-375/U and the two Audio Oscillators TS-382/U to the dummy microphone as illustrated in figure 2-2. Set one audio oscillator to an output frequency of 1000 cps and the second to 1700 cps. Adjust the output level of each to 0.23 volt rms as measured across the microphone jack. Disconnect the TS-375/U.

c. Connect the TS-375/U and Oscilloscope TEK 545 across the dummy load through a 25 μμf capacitor. Adjust the oscilloscope for a horizontal sweep capable of reproducing two or three modulated waveform patterns.

d. Connect a telegraph key to test point 6.

e. Operate the function switch on the radio set control to the "SSB/FSK" position.

f. Operate the channel select switches for an output frequency of 14,249.5 kc ("TCZZ").

g. Key the transmitter by depressing the telegraph key and observing the output on the oscilloscope and vtvm. If normal, the output will appear as a 100 percent modulated waveform without excessive peak clipping. A minimum output of 50 volts rms should be noted on the vtvm.

h. If these readings are obtained, connect the probe of the vtvm to "J1402" (located on the modulator subassembly) and note the voltage reading with the transmitter keyed. A reading of at least —2 volts dc should be obtained. If not, readjust the gain control ("R1403") until a —2 to —3-volt reading is obtained. Before making this adjustment, make certain the clipping control ("R1404") is set to maximum clockwise rotation.

Note

The voltage at "J1402" will vary from —1 to —10 volts for frequencies other than 14,249.5 kc.

i. Readjust the clipping control ("R1404") counterclockwise until the voltage measured at "J1402" just starts to decrease.

j. Remove both audio signals from the input of the dummy microphone. Key the transmitter and measure the residual r-f voltage across the dummy load with the vtvm. Adjust the carrier balance control ("R1430") for a minimum reading as indicated by the vtvm. If trouble is experienced from ripple in the 27.5 volt dc line coupling into the microphone input circuit, temporarily reduce the gain control setting to zero input while making this adjustment.

k. After proper adjustment of the carrier balance control, reset the gain and clipping controls as described in steps h and i and recheck the output levels as described in steps a through g.

2-15. AME OUTPUT POWER.

a. Connect the dummy microphone to test point 5.

b. Connect the Audio Oscillator TS-382/U to the dummy microphone input. Set the audio oscillator to 1000 cps at an output level of 0.46 volt rms as measured across the microphone jack by the vtvm.

c. Connect the TS-375/U and Oscilloscope TEK 545 across the dummy load through a 25-μμf capacitor. Adjust the oscilloscope for a horizontal sweep capable of reproducing two or three modulated waveform patterns, and the vtvm to the 120 volt range.

d. Connect a telegraph key to test point 6.

e. Operate the function switch on the radio set control to the "AME" position and set the channel selector switches for an output frequency of 14,249.5 kc ("TCZZ").

f. Key the transmitter by depressing the telegraph key and observe the waveform on the oscilloscope and the voltage measured by the vtvm. The waveform on the oscilloscope should show a normal 100 percent modulated pattern relatively free of peak clipping. The r-f voltage across the dummy load should be a minimum of 50 volts rms.

g. If a 100 percent modulated waveform is not obtained, adjust the carrier control ("R1437") for correct output.

2-16. SIDETONE TESTS. With the equipment setup as described in the preceding paragraph, perform the following operations:

a. Connect a headset to the "PHONE" jack (test point 4) or to terminal b of P3801/J3801, and monitor the signal as the level and frequency of the audio oscillator is varied. The varying signals should be clearly audible within the frequency range (approximately 300 to 3500 cps) of the audio amplifier in the equipment.

b. Vary the "PHONE SIDETONE" control (R106 on the front panel subassembly) and notice if the amplitude of the audio oscillator output signal is controllable.

c. With the TS-382/U set for an output level of 1 volt at 1000 cps, adjust R106 for a comfortable headset level.

d. Operate the function switch on the radio set control to the "CW" position and note the 400 cps signal.

e. Vary the "CW SIDETONE" control (R107 on the front panel subassembly) and notice if the amplitude of the 400 cps signal is variable.

f. Adjust R107 for a comfortable headset level.

2-17. RECEIVER TESTS.

2-18. SENSITIVITY. The operator must perform the following operations:

Note

To assure reliability of the sensitivity tests outlined in the following steps, all procedures may be performed in a screen room if extraneous interference affects the results.

a. Connect Signal Generator AN/URM-25 to jack J109 (test point 3). Adjust for an output of 2.75 mc at 1000 microvolts, modulated 30 percent at 1000 cps. Use Frequency Meter AN/USM-26 to set the AN/URM-25 to the correct frequency.

b. Connect Output Meter TS-585/U to test point 4 and adjust to the 500-milliwatt range with an internal impedance of 300 ohms.

c. Operate the function switch on the radio set control to the "AME" position and the channel selector switches to an operating frequency of 2.75 mc.

d. Adjust the "SENS" control R116 on the front-panel subassembly to maximum clockwise rotation.

e. Adjust the "AUDIO" control (R109 on the front panel subassembly) for an audio power output of 300 milliwatts as measured by the output meter.

f. Reduce the output level of the AN/URM-25 to 5 microvolts. The output meter should indicate not less than 100 milliwatts.

g. Remove the modulation. The signal-plus-noise to noise ratio should be at least 6 db (modulation-on to modulation-off ratio of 4 to 1 as read on Output Meter TS-585/U).

h. Operate the function switch on the radio set control of the "CW" position.

i. Observe the power output indication on the output meter with the signal generator adjusted to an output level of 5 microvolts. Adjust BFO for approximately 251 kc. A minimum indication off 100 milliwatts should be noted.

j. Remove the r-f input signal and observe the indication on the output meter. The reading should change a minimum of 10 (indication in the r-f on mode at least 10 times that in the r-f off mode). Repeat the preceding steps for at least one channel in each of the four bands.

k. Set the function switch on the radio set control to the "SSB/FSK" position and tune the equipment (receiver and signal generator) to a frequency of 14249. 5 kc ("TCZZ"). Check the signal generator output frequency with the frequency meter and adjust the output level of the signal generator to 1.5 microvolts.

l. Slowly increase the output frequency of the signal generator until an indicated output of 14,250.5 kc is observed on the frequency meter.

m. Reduce output level of signal generator to 1.5 microvolts and note meter reading. A minimum reading of 100 milliwatts should be indicated by the output meter.

n. Repeat steps k through m for at least one channel in each of the four bands. Always remember to reset the output of the signal generator for a frequency 1 kc higher than the frequency for which the receiver is tuned.

Note

The preceding receiver tests can be monitored with a headset connected to terminal b of P3801/J3801. When a 300-ohm headset such as the H–1/AR or the H–4/AR is connected to either the "PHONE" jack or to terminal b of P3801/J3801, Output Meter TS–585/U should be disconnected. The TS–585/U and a low-impedance headset should not be connected across the audio output terminals at the same time or transformer T1301 will be mismatched and the test results will be inaccurate. A high-impedance monitor, such as described in figure 3–1, item 22, may be used in parallel with the TS–585B/U if it is desired to monitor the audio signal during the test procedures.

2–19. INSTALLATION OF EQUIPMENT.

2–20. GENERAL. The individual components of the system must be mounted in a location convenient to the existing radio operating facilities in the aircraft. Every consideration must be given in the location of equipment and the design of installation details to promote operator efficiency, ease of adjustment, and component replacement. No attempt is made in this manual to present complete installation instructions, since the particular type of aircraft involved will determine the installation requirements. A general procedure is outlined in the following paragraphs. Figure 2–1 shows a typical installation.

2–21. RADIO RECEIVER-TRANSMITTER RT–618S–1/MC.

2–22. LOCATION. The main component of the system should be located in a position that is reasonably accessible and well ventilated. Adequate clearance for mounting the main component on Mounting 350S–1 or 350S–3 must be provided. Access to the front panel is necessary to permit removal of the component and to provide for observation of the front panel mounted meter.

2–23. MOUNTING. Normally, the receiver-transmitter is mounted on Mounting 350S–1 or 350S–3. Figure 2–6 shows the outline and mounting dimensions of the main component mounted on either mounting. Note that all power and control connections are made to terminals located on the filter unit at the rear of Mounting 350S–1 or 350S–3. The 350S–1 or 350S–3 should be secured to the mounting shelf by means of No. 8 screws, nuts, and lockwashers. The filter unit is held in place by four screws at the rear of Mounting 350S–1 or 350S–3. The cabling may be connected to the filter unit while removed from the 350S–1 or 350S–3. Make certain all grounding straps are fastened securely under the vibration isolator feet of the mounting to assure good electrical connection. Perform the following steps to mount the receiver-transmitter:

a. Loosen the locking mechanisms by rotating the two wing nuts counterclockwise as far as possible.

b. Place the receiver-transmitter on the mounting and push towards the rear, making certain the plugs on the chassis mate properly with the jacks on the mounting.

c. Engage the locking mechanisms and tighten the two wing nuts.

d. Safety-wire the locking mechanisms.

2–24. POWER SUPPLY 416W–1.

2–25. LOCATION. The power supply can be placed in any convenient location that is accessible and reasonably well ventilated. Cabling requirements should be considered before choosing the location as the power supply provides power for operation of the receiver-transmitter and the antenna tuner.

2–26. MOUNTING. Power Supply 416W–1 is normally mounted on Mounting 350T–1. Figure 2–7 shows the outline and mounting dimensions of the component on the mounting. The 350T–1 should be secured on the mounting shelf by means of No. 8 screws, nuts, and lockwashers. The grounding straps should be fastened securely under the vibration isolator feet to assure good electrical contact. To install the 416W–1 on Mounting 350T–1, perform the following operations:

a. Operate the extractor mechanism by rotating the middle thumbscrew as far as possible in a counterclockwise position.

b. Place the 416W–1 on the 350T–1 and push toward the rear so the front panel drops into the extractor slot.

c. Rotate the middle thumbscrew clockwise until the rear connector is fully engaged.

d. Engage, tighten, and safety-wire the locking mechanisms.

2–27. RADIO SET CONTROL CPC–1.

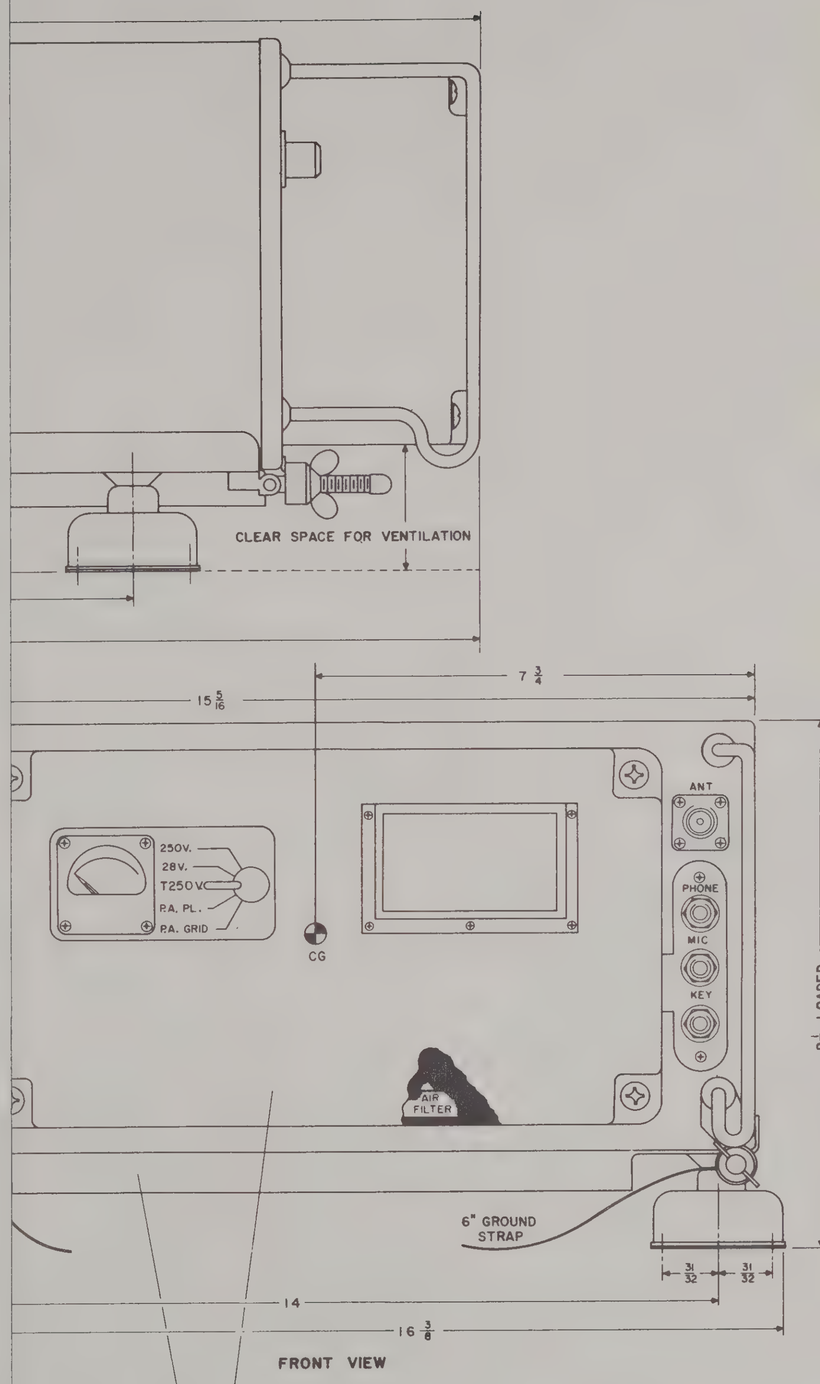
2–28. LOCATION AND MOUNTING. Radio Set Control CPC–1 is mounted as part of the control panel at the pilot's or radio operator's position. Secure the radio set control by means of the four Dzus fasteners. Outline and mounting dimensions for the radio set control are shown in figure 2–8.

2–29. AUTOMATIC ANTENNA TUNER 180L–3.

2–30. GENERAL. The Automatic Antenna Tuner 180L–3 is not supplied as a part of Radio Set 618S–1. The antenna tuner is normally mounted on Mounting 350D–3. Figure 2–9 shows the outline and mounting dimensions required for the component and mounting. Complete installation details for this component are outlined in the applicable service manual.

2–31. SYSTEM INTERCONNECTIONS.

2–32. GENERAL. Location of the individual components of the system is optional since space allocation is dependent upon the aircraft type. Therefore, the interconnecting cables must be fabricated from bulk supplies. The physical cabling layout must be determined for each particular installation by the installing



tline and Mounting Dimensions, Receiver-Transmitter 618S-MC

Note

The preceding receiver tests can be monitored with a headset connected to terminal b of P3801/J3801. When a 300-ohm headset such as the H–1/AR or the H–4/AR is connected to either the "PHONE" jack or to terminal b of P3801/J3801, Output Meter TS–585/U should be disconnected. The TS–585/U and a low-impedance headset should not be connected across the audio output terminals at the same time or transformer T1301 will be mismatched and the test results will be inaccurate. A high-impedance monitor, such as described in figure 3–1, item 22, may be used in parallel with the TS–585B/U if it is desired to monitor the audio signal during the test procedures.

2–19. INSTALLATION OF EQUIPMENT.

2–20. GENERAL. The individual components of the system must be mounted in a location convenient to the existing radio operating facilities in the aircraft. Every consideration must be given in the location of equipment and the design of installation details to promote operator efficiency, ease of adjustment, and component replacement. No attempt is made in this manual to present complete installation instructions, since the particular type of aircraft involved will determine the installation requirements. A general procedure is outlined in the following paragraphs. Figure 2–1 shows a typical installation.

2–21. RADIO RECEIVER-TRANSMITTER RT–618S–1/MC.

2–22. LOCATION. The main component of the system should be located in a position that is reasonably accessible and well ventilated. Adequate clearance for mounting the main component on Mounting 350S–1 or 350S–3 must be provided. Access to the front panel is necessary to permit removal of the component and to provide for observation of the front panel mounted meter.

2–23. MOUNTING. Normally, the receiver-transmitter is mounted on Mounting 350S–1 or 350S–3. Figure 2–6 shows the outline and mounting dimensions of the main component mounted on either mounting. Note that all power and control connections are made to terminals located on the filter unit at the rear of Mounting 350S–1 or 350S–3. The 350S–1 or 350S–3 should be secured to the mounting shelf by means of No. 8 screws, nuts, and lockwashers. The filter unit is held in place by four screws at the rear of Mounting 350S–1 or 350S–3. The cabling may be connected to the filter unit while removed from the 350S–1 or 350S–3. Make certain all grounding straps are fastened securely under the vibration isolator feet of the mounting to assure good electrical connection. Perform the following steps to mount the receiver-transmitter:

a. Loosen the locking mechanisms by rotating the two wing nuts counterclockwise as far as possible.

b. Place the receiver-transmitter on the mounting and push towards the rear, making certain the plugs on the chassis mate properly with the jacks on the mounting.

c. Engage the locking mechanisms and tighten the two wing nuts.

d. Safety-wire the locking mechanisms.

2–24. POWER SUPPLY 416W–1.

2–25. LOCATION. The power supply can be placed in any convenient location that is accessible and reasonably well ventilated. Cabling requirements should be considered before choosing the location as the power supply provides power for operation of the receiver-transmitter and the antenna tuner.

2–26. MOUNTING. Power Supply 416W–1 is normally mounted on Mounting 350T–1. Figure 2–7 shows the outline and mounting dimensions of the component on the mounting. The 350T–1 should be secured on the mounting shelf by means of No. 8 screws, nuts, and lockwashers. The grounding straps should be fastened securely under the vibration isolator feet to assure good electrical contact. To install the 416W–1 on Mounting 350T–1, perform the following operations:

a. Operate the extractor mechanism by rotating the middle thumbscrew as far as possible in a counterclockwise position.

b. Place the 416W–1 on the 350T–1 and push toward the rear so the front panel drops into the extractor slot.

c. Rotate the middle thumbscrew clockwise until the rear connector is fully engaged.

d. Engage, tighten, and safety-wire the locking mechanisms.

2–27. RADIO SET CONTROL CPC–1.

2–28. LOCATION AND MOUNTING. Radio Set Control CPC–1 is mounted as part of the control panel at the pilot's or radio operator's position. Secure the radio set control by means of the four Dzus fasteners. Outline and mounting dimensions for the radio set control are shown in figure 2–8.

2–29. AUTOMATIC ANTENNA TUNER 180L–3.

2–30. GENERAL. The Automatic Antenna Tuner 180L–3 is not supplied as a part of Radio Set 618S–1. The antenna tuner is normally mounted on Mounting 350D–3. Figure 2–9 shows the outline and mounting dimensions required for the component and mounting. Complete installation details for this component are outlined in the applicable service manual.

2–31. SYSTEM INTERCONNECTIONS.

2–32. GENERAL. Location of the individual components of the system is optional since space allocation is dependent upon the aircraft type. Therefore, the interconnecting cables must be fabricated from bulk supplies. The physical cabling layout must be determined for each particular installation by the installing

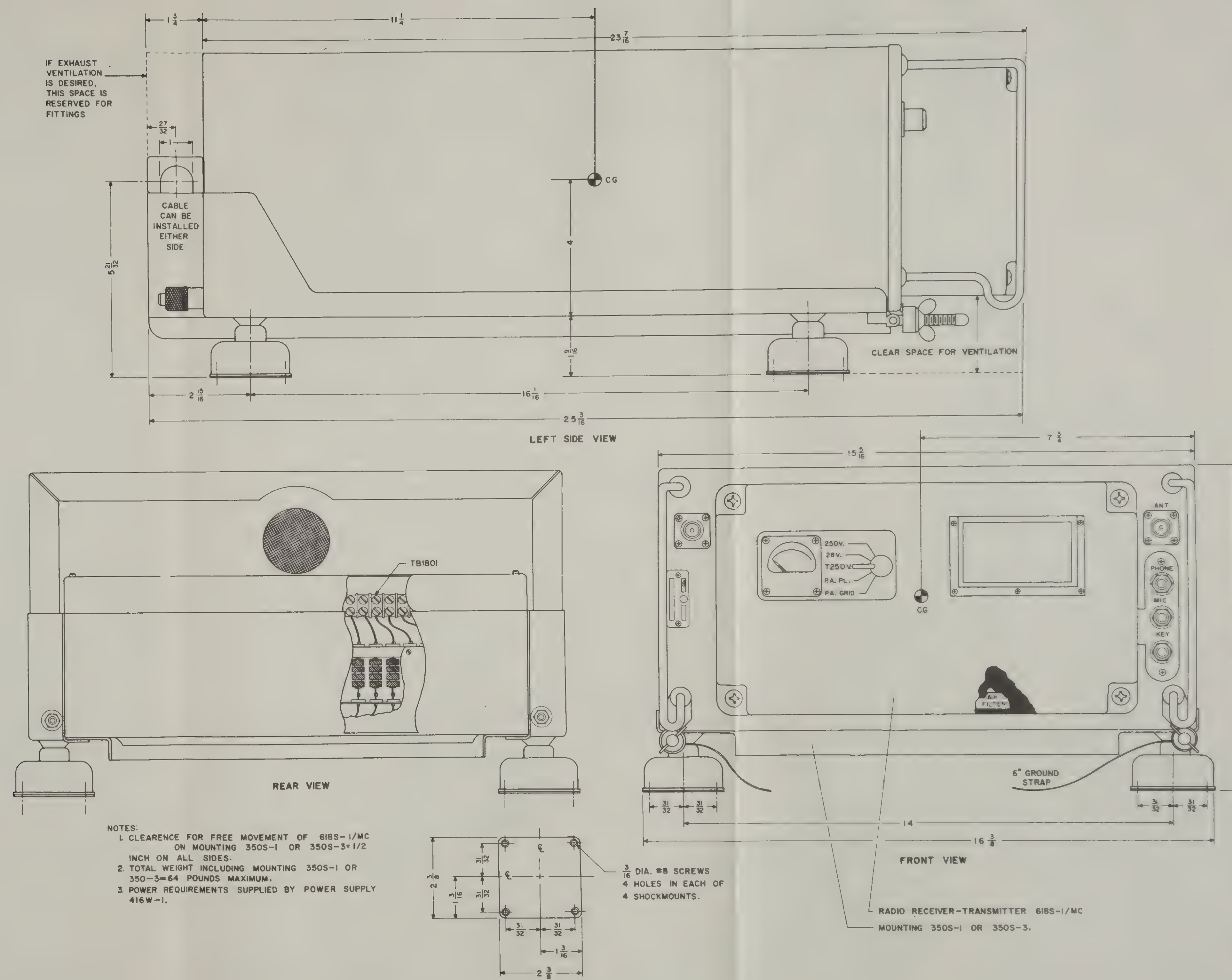


Figure 2-6. Outline and Mounting Dimensions, Receiver-Transmitter 618S-MC

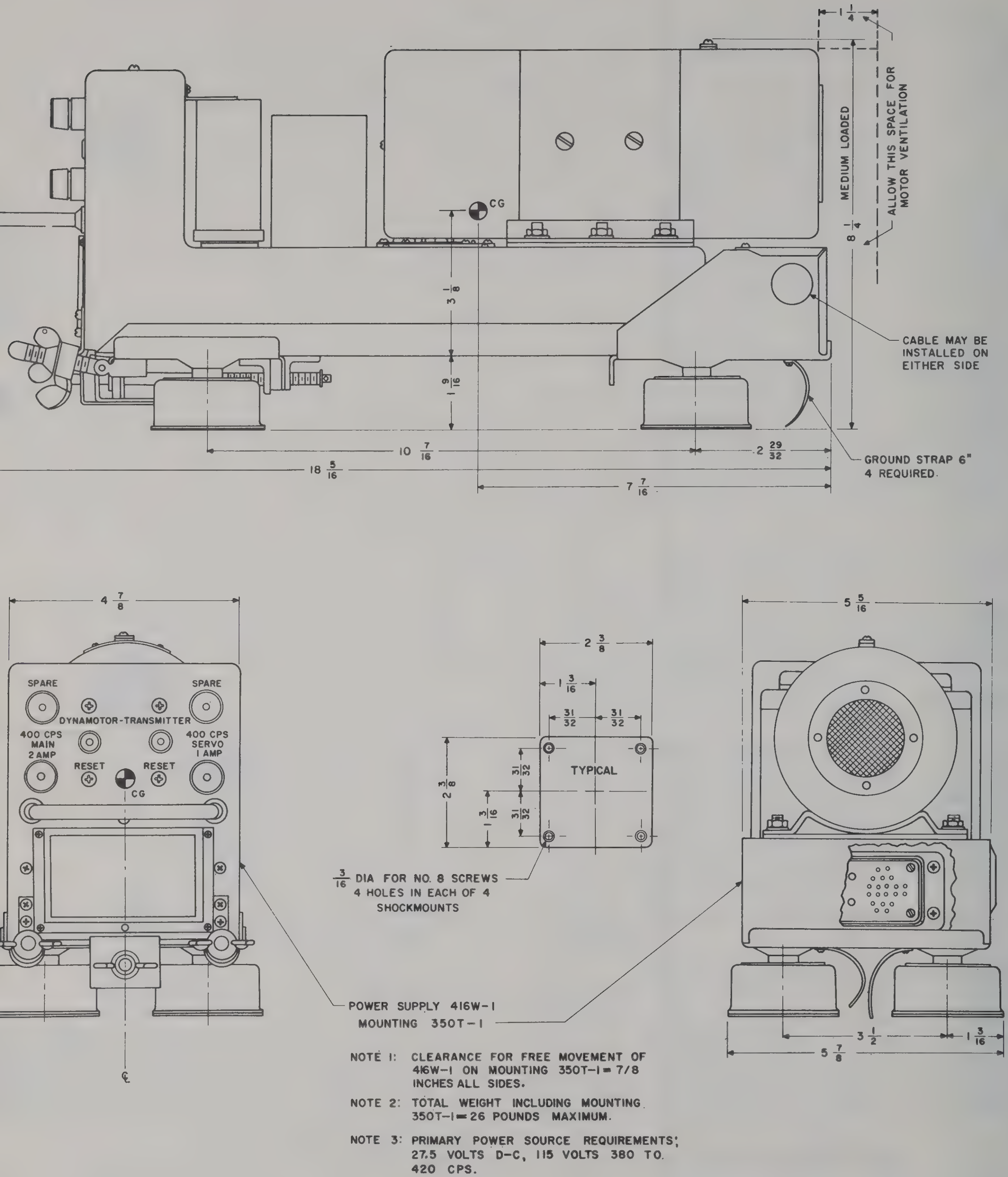


Figure 2-7. Outline and Mounting Dimensions, Power Supply 416W-1

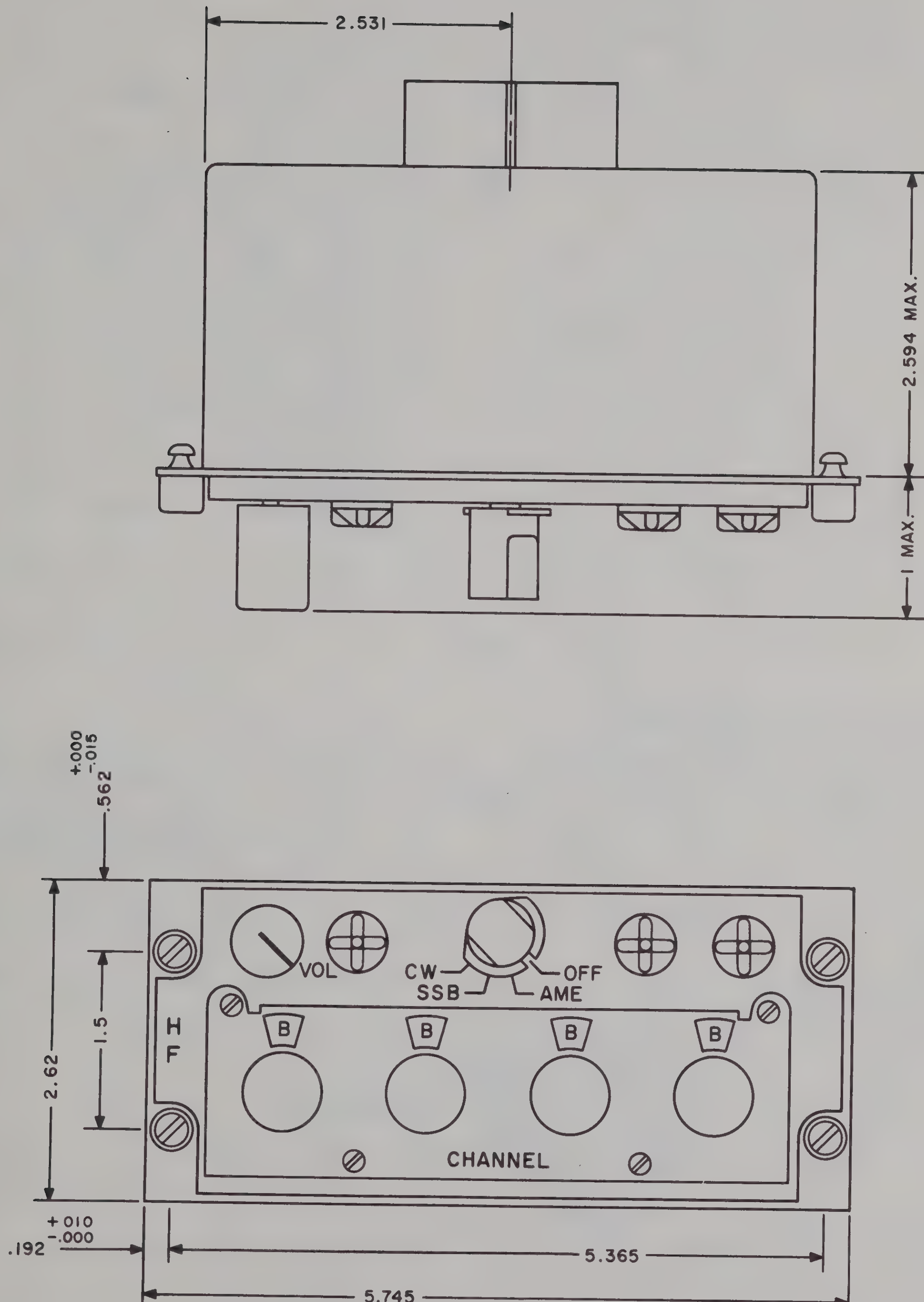


Figure 2–8. Outline and Mounting Dimensions, Radio Set Control CPC–1

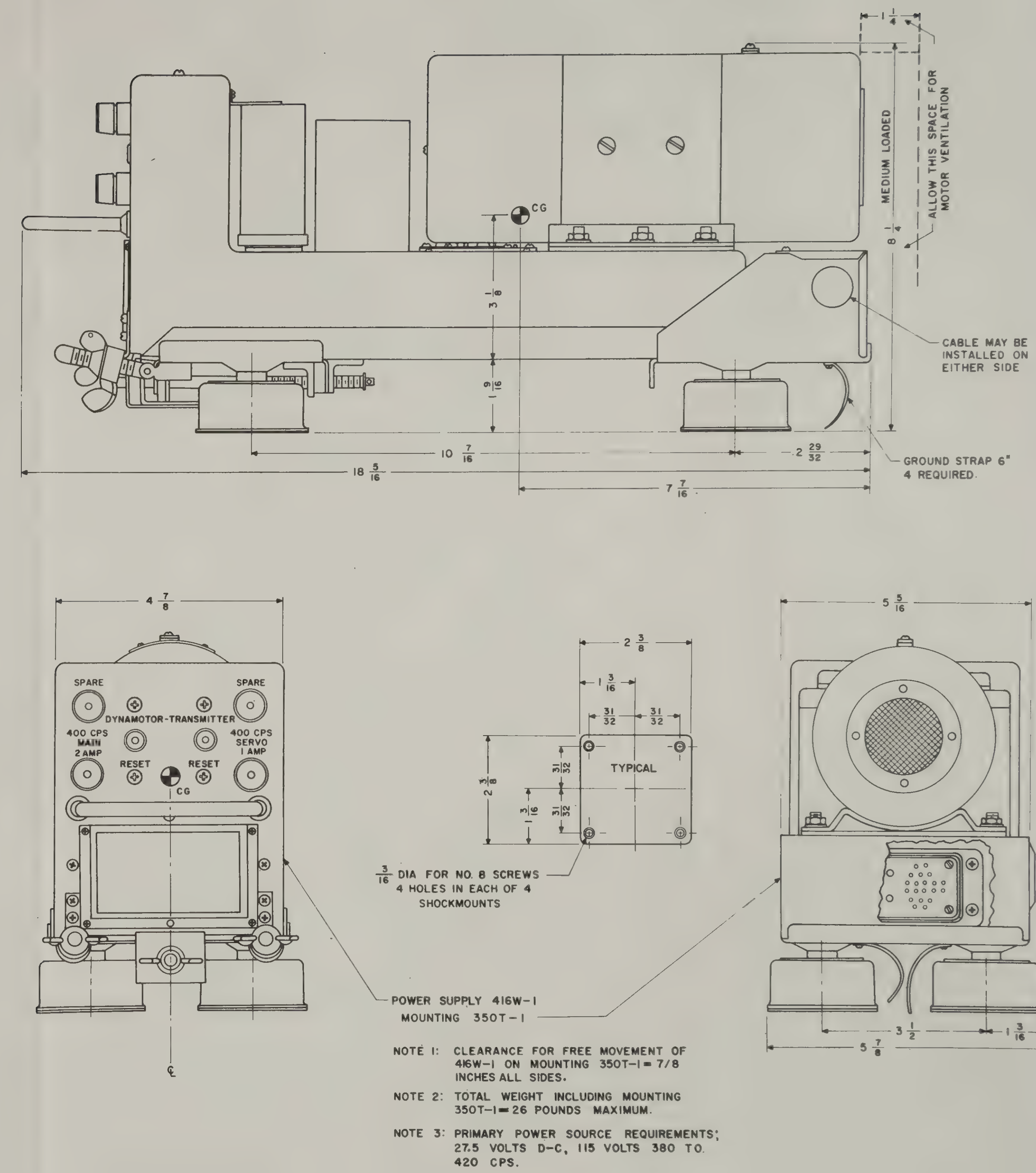


Figure 2-7. Outline and Mounting Dimensions, Power Supply 416W-1

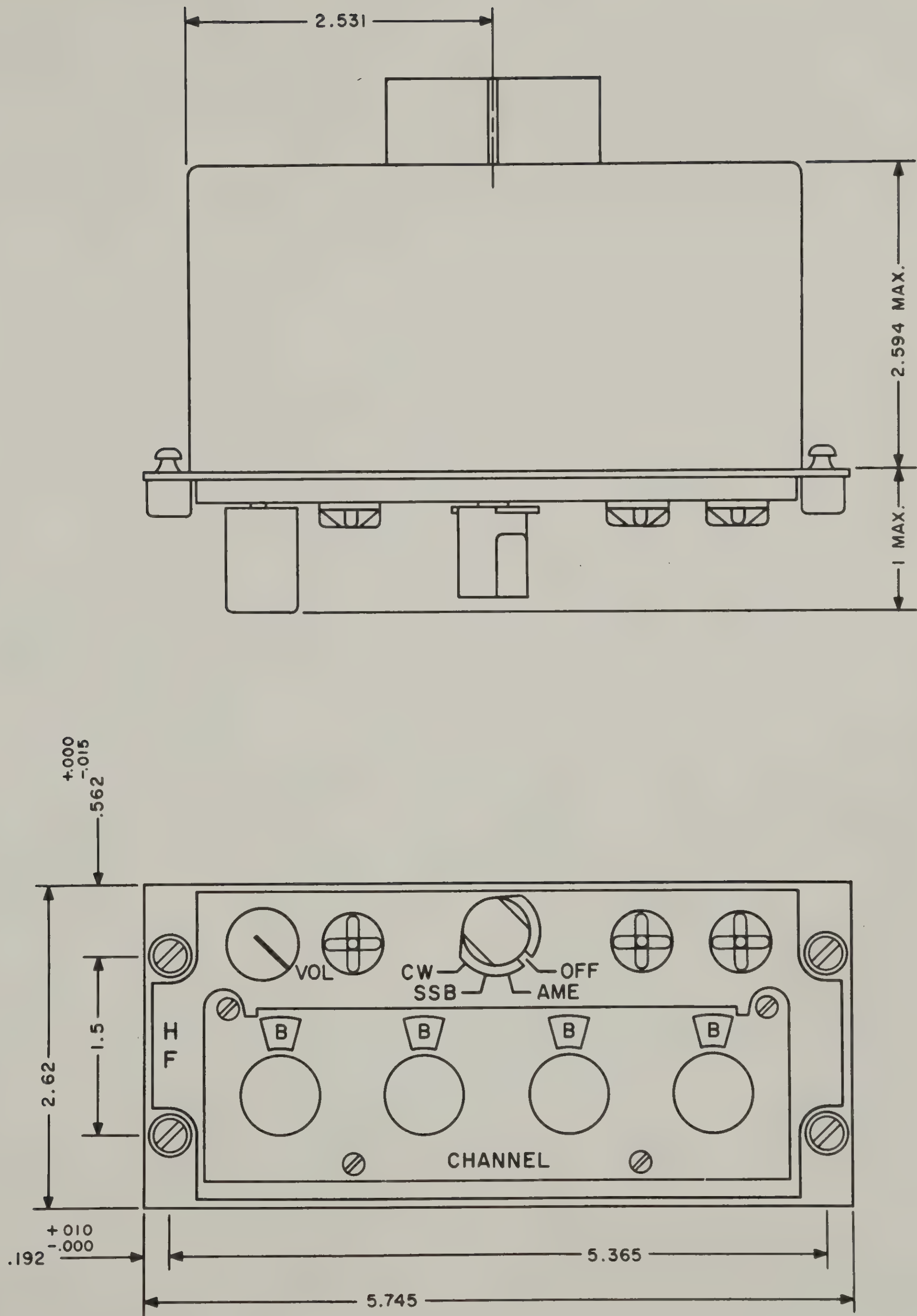
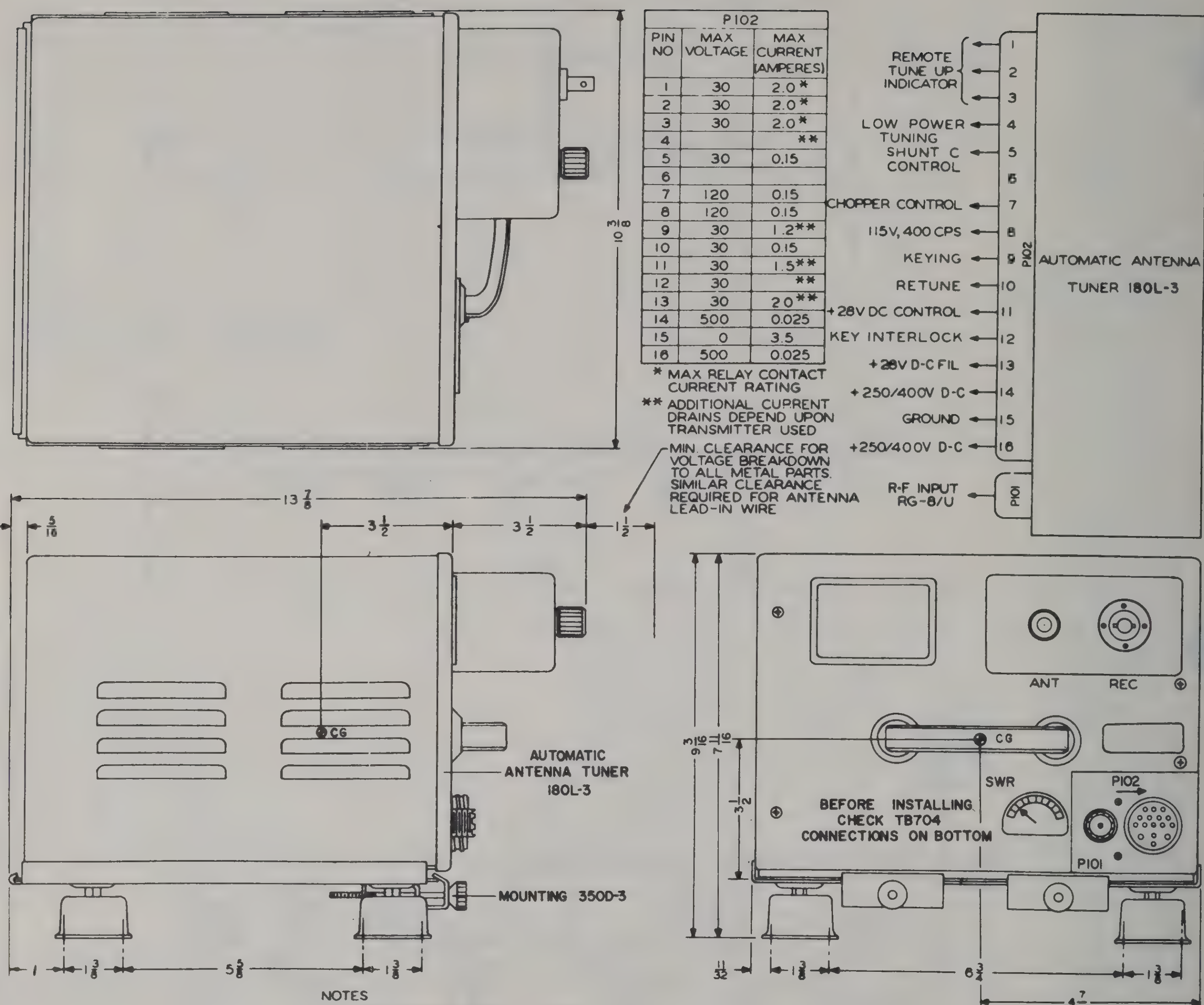


Figure 2–8. Outline and Mounting Dimensions, Radio Set Control CPC–1



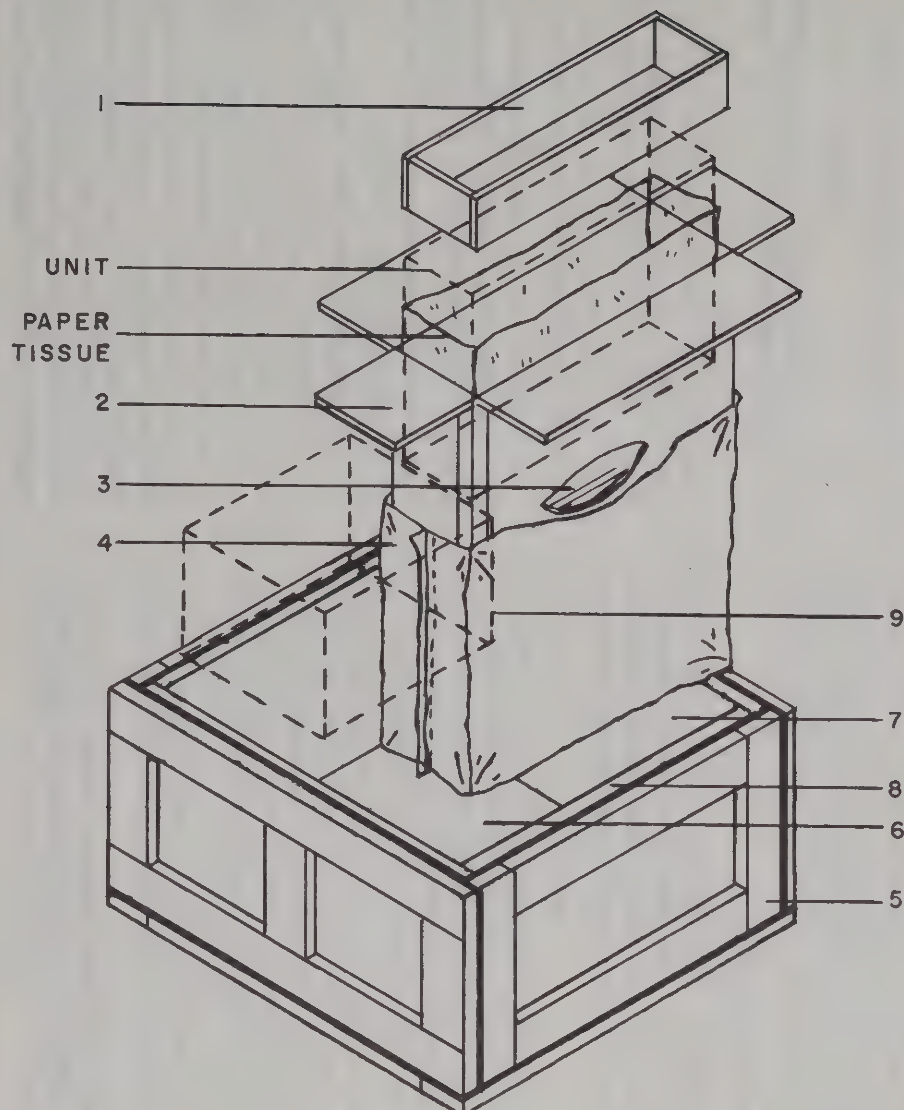
P102		
PIN NO	MAX VOLTAGE	MAX CURRENT (AMPERES)
1	30	2.0*
2	30	2.0*
3	30	2.0*
4		**
5	30	0.15
6		
7	120	0.15
8	120	0.15
9	30	1.2**
10	30	0.15
11	30	1.5**
12	30	**
13	30	2.0**
14	500	0.025
15	0	3.5
16	500	0.025

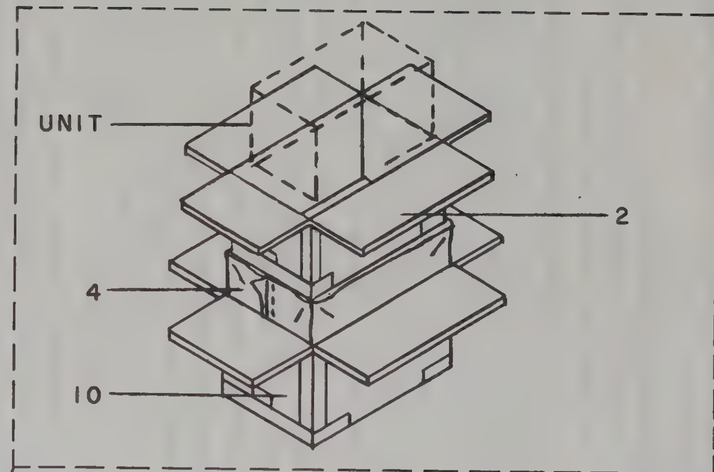
* MAX RELAY CONTACT CURRENT RATING

** ADDITIONAL CURRENT DRAINS DEPEND UPON TRANSMITTER USED

NOTES
1. APPROXIMATE WEIGHT 20 LBS
2. 16 MTG HOLES .196 DIA
3. ALL DIMENSIONS ARE IN INCHES
4. CLEARANCE OF 1/2 INCH REQUIRED ON ALL SIDES AND TOP FOR FREE MOVEMENT OF 180L-3 ON MOUNTING 350D-3.
5. SPOT FACE 4 OF 16 MOUNTING HOLES FOR CONTACT WITH GROUNDING STRIPS
6. 8 INCH CLEARANCE REQUIRED AT FRONT FOR REMOVAL OF CONNECTOR AND FRONT PANEL

Figure 2-9. Outline and Mounting Dimensions, Antenna Tuner 180L-3





1	TRAY (TOP)	MIL-B-636
2	CONTAINER (CORR)	MIL-B-636
3	PAD (BOTTOM)	MIL-B-636
4	WVP BARRIER	MIL-B-131
5	CONTAINER (PLYWD) SHIPPING	MIL-B-601
*6	BONDED POLYURETHANE-ESTER (40X19 1/2)	
*7	BONDED POLYURETHANE-ESTER (40X8 1/2)	
*8	BONDED POLYURETHANE-ESTER (16 1/2 X8 1/2)	
9	RADIO SET CONTROL PACKAGE	
10	CONTAINER (CORR) SHIPPING	MIL-B-636

* MIL-P-26514

Figure 2–10. Packaging Data

activity. The following general steps should be closely adhered to when installing the cables between components.

a. Allow sufficient slack in cables to avoid restricting movement on mountings, and to facilitate removal and replacement of the cable connectors.

b. Run cables in positions that will reduce chances of damage due to vibration.

c. Avoid running cables over sharp edges.

d. Avoid sharp bends allowing, in general, a bending radius of at least 3.5 inches.

e. Securely anchor cables to the aircraft structure using clamps or lacing.

f. Figure 3–5 shows the required intercomponent cabling details.

2–33. POST INSTALLATION INSPECTION.

2–34. GENERAL. A thorough check of the complete installation should be made before power is applied to the equipment. Check as follows:

a. Check connections. Make sure the locking rings on connectors are tight.

b. Check the wires entering multiple connectors to be sure the insulation has not been stripped too far back, causing wires to short together.

c. Check mountings to ascertain if the components are mounted securely and the locking mechanisms are tight.

d. Check cabling to ascertain if it will sustain severe and prolonged vibration.

e. Check primary power source connections to make certain that no short circuits exist in the input power line connections.

2–35. PREFLIGHT TESTS.

2–36. GENERAL. The following tests should be performed with the equipment completely installed in the aircraft. The aircraft should be outside the hangar with the engines running while performing these tests.

Note

Extreme care should be taken to avoid interference with any local communication channel. After each new channel selection, listen in the headset to determine if the channel is in use before proceeding with further tests.

a. Operate the function switch on Radio Set Control CPC–1 to the "AME" position and allow the equipment to warm-up for at least 10 minutes.

b. Rotate the meter selector switch to the "250 V." position. The meter indicator should swing into the red area.

c. Rotate the meter selector switch to the "28 V" position. The meter indication should be in the red area.

d. Rotate the meter selector switch to the "P.A. GRID" position. The meter indication should be in the red area.

e. Rotate the meter selector switch to the "T250V." position and depress the microphone push-to-talk or telegraph key. The meter indication should be near the red area.

f. Rotate the meter selector switch to the "P.A. PL" position. The meter indication should be in the red area with the transmitter keyed.

g. With the conditions as in step f, talk into the microphone. The meter indication should vary with the modulation and the transmission should be heard in the headset through the sidetone circuit.

h. Operate the function switch on the radio set control to the "SSB/FSK" position.

i. Depress the push-to-talk switch on the microphone and talk into the microphone while observing the meter reading. The meter reading should be in the red area and will increase with the modulation. The transmission should also be heard in the headset.

j. Operate the function switch on the radio set control to the "CW" position.

k. Depress the telegraph key. A 400-cps sidetone signal should be heard in the headset.

l. Operate the function switch to the "AME, SSB/FSK", and "CW" positions in succession while noting the characteristic hiss in the headset for each position. The microphone push-to-talk or telegraph key must be released while performing this check.

Note

In general, set R116 as near to maximum as noise background on noisiest channel will permit.

m. With the function switch in the "AME" or "SSB/FSK" position, operate the channel selector switches to an active station and note the received signal.

n. Vary the 'VOL" control on the radio set control to make certain the signal amplitude is controllable.

o. Operate the function switch to the "CW" position and the channel selector switches to an active cw station. Note the presence of the received sidetone.

p. Repeat the preceding steps for at least one channel in each of the four bands.

2–37. PREPARATION FOR RESHIPMENT.

2–38. GENERAL. Removal of the installed components of Radio Set 618S–1/MC is accomplished by disconnecting the cables and reversing the installation procedure described in paragraphs 2–19 through 2–29. No special provisions for repacking the equipment are necessary beyond use of reasonable care. It is recommended that the original packing material (or substitute material having similar characteristics) be used when repacking the equipment. Figure 2–10 shows the manner in which the components are to be packed.

SECTION III
TEST EQUIPMENT AND SPECIAL TOOLS

3-1. TEST EQUIPMENT REQUIRED.

3-2. The test equipment listed in the table of figure 3-1 or equipment of equal or superior characteristics must be used in the performance of the tests outlined in the various sections of this manual. Refer to the applicable operating manuals for instructions in the use of Test Set 478H-1 and Dynamotor Test Set TS-414/U.

3-3. USE OF ALTERNATE TEST EQUIPMENT.

3-4. When a voltmeter is used in place of Output Meter TS-585B/U, a 300-ohm non-inductive resistor should be placed in parallel with the voltmeter to afford proper loading of the audio output transformer.

3-5. SPECIAL TOOLS.

3-6. Special tools required in the performance of maintenance procedures are listed in figure 3-3. These tools are included with the radio set, and are used for removal and replacement of electrical and mechanical parts.

3-7. CABLE FABRICATION.

3-8. SYSTEM CABLING. Figure 2-1 illustrates a typical bench harness setup for preinstallation tests and adjustments. The power and control cables illustrated must be fabricated, using bulk supplies. Reference must be made to the external wiring diagram, figure 3-5, for all necessary cabling information, such as AN nomenclature of plugs and connectors, functions of interconnecting wires, and wire sizes. Further information for fabricating cables can be obtained from publication AN Connector Handbook AN03-5-90. Figures 3-6 and 3-7 illustrate the method of connecting the r-f cables to the r-f plugs.

3-9. SUBASSEMBLY CABLING. Figure 3-8 lists the cables required for maintenance and troubleshooting procedures for the individual subassemblies of the radio set. These cables are to be fabricated from bulk supplies, as illustrated in figures 3-9 through 3-11. The total number of each type of cable required for interconnection with the main chassis is listed in the maximum number required column of figure 3-8. This total is only required when all the subassemblies are removed from the main chassis. As this would be only in rare instances, it is suggested that only the number of cables required for checking each removed subassembly individually, be fabricated.

Figure and Item No.	Name	AN Type Designation	Alternate	Use
1 (Figure 3-4)	Test Set	478H-1 (Modified)		Subassembly testing
2	Dynamotor Test Set	TS-414/U		Dynamotor testing
3	Tube Tester	TV-3B/U	Hickock Model 539A	Tube testing
4	Multimeter	TS-352/U	Simpson 260	Continuity and general voltage measurements
5	Signal Generator	AN/URM-25	Measurements Corp. Model 65B or 82	R-F tests and alinement
6	Vacuum Tube Voltmeter	TS-375/U	Hewlett-Packard Model 410B	R-F and a-f voltage tests
7	Audio Oscillator (2 required)	TS-382/U	Hewlett-Packard Model 200c	A-F tests, alinement, and adjustments
8	Oscilloscope		Tektronix Model TEK 545	Modulation, r-f, and a-f tests
9	Output Meter	TS-585B/U	Daven Model OP182	A-F power output tests
10	Frequency Meter	AN/USM-26	Hewlett-Packard Model 524B	Checking of AN/URM-25 and transmitter output frequencies

Figure 3-1. Test Equipment Required (Sheet 1 of 2)

Figure and Item No.	Name	AN Type Designation	Alternate	Use
11	Dummy Load (51.5 ohms)		Bird Model 82	Transmitter output loading
12	Headset, plug, and cord	H-4/AR or H-1/AR		Monitoring of a-f signals
13	Microphone, plug, and cord	NAF-213264-6 or ANB-M-C1		Modulation tests of transmitter
14	Capacitor, 30 μf, 25 to 50 volts, dc			For dummy microphone (see figure 3-2)
15	Capacitor, 25 μμf, 600 to 1000 volts, dc			Coupling of TEK 545 to transmitter antenna
16	Capacitor, 0.01 μf, 600 volts dc			
17	82 ohm, ±5 percent, 0.5 watt resistor			For dummy microphone (see figure 3-2)
18	1000 ohm, ±5 percent, 0.5 watt resistor (2 required)			Isolation of audio oscillators (see figure 2-2)
19	1 megohm, ±10 percent, 0.5 watt resistor			For connection of AN/USM-26 to antenna
20	T-Adaptor	UG-413/U		Connection of dummy load to antenna output
21	Maintenance Kit	Supplied with Radio Set 618S-1/MC		Mechanical alinement and adjustments.
22	Audio Monitor: A high impedance (10,000 ohms minimum) headset or amplifier with loudspeaker for monitoring of audio signals with the output meter connected.			
23	Dummy Microphone: A device for connecting the audio oscillator to the microphone jack in such a manner as to simulate the action of a real microphone (see figure 3-2).			
24	Power Source: Capable of delivering 27.5 volts dc at 28 amperes continuously and 100 amperes surge, and 115 volts, 380 to 420 cps at 1.025 amperes.			
25	Capacitor, 10 μμf, 600 volts, dc			Discriminator Subassembly alinement
26	Capacitor, 47 μμf, 600 volts, dc			Discriminator Subassembly alinement
27	Capacitor, 0.1 μf, 600 volts, dc			Channelizer Subassembly alinement

Figure 3-1. Test Equipment Required (Sheet 2 of 2)

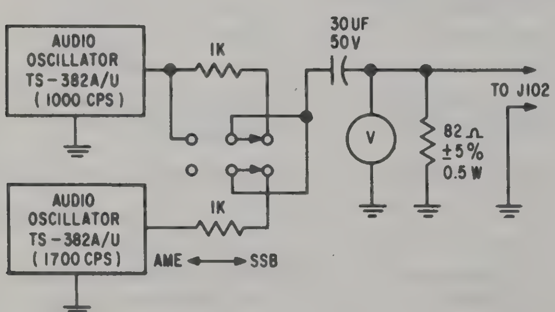


Figure 3-2. Dummy Microphone Schematic Diagram

Part Number	Name
024 2900 00	No. 4 Bristo Wrench
024 9730 00	No. 6 Bristo Wrench
024 0019 00	No. 8 Bristo Wrench
024 9710 00	No. 10 Bristo Wrench

Figure 3-3. Special Maintenance Tools Supplied

Adapter Box for Modified Test Set 478H-1

Figure and Item No.	Name	AN Type Designation	Alternate	Use
11	Dummy Load (51.5 ohms)		Bird Model 82	Transmitter output loading
12	Headset, plug, and cord	H-4/AR or H-1/AR		Monitoring of a-f signals
13	Microphone, plug, and cord	NAF-213264-6 or ANB-M-C1		Modulation tests of transmitter
14	Capacitor, 30 μf, 25 to 50 volts, dc			For dummy microphone (see figure 3-2)
15	Capacitor, 25 μμf, 600 to 1000 volts, dc			Coupling of TEK 545 to transmitter antenna
16	Capacitor, 0.01 μf, 600 volts dc			
17	82 ohm, ±5 percent, 0.5 watt resistor			For dummy microphone (see figure 3-2)
18	1000 ohm, ±5 percent, 0.5 watt resistor (2 required)			Isolation of audio oscillators (see figure 2-2)
19	1 megohm, ±10 percent, 0.5 watt resistor			For connection of AN/USM-26 to antenna
20	T-Adaptor	UG-413/U		Connection of dummy load to antenna output
21	Maintenance Kit	Supplied with Radio Set 618S-1/MC		Mechanical alinement and adjustments.
22	Audio Monitor: A high impedance (10,000 ohms minimum) headset or amplifier with loudspeaker for monitoring of audio signals with the output meter connected.			
23	Dummy Microphone: A device for connecting the audio oscillator to the microphone jack in such a manner as to simulate the action of a real microphone (see figure 3-2).			
24	Power Source: Capable of delivering 27.5 volts dc at 28 amperes continuously and 100 amperes surge, and 115 volts, 380 to 420 cps at 1.025 amperes.			
25	Capacitor, 10 μμf, 600 volts, dc			Discriminator Subassembly alinement
26	Capacitor, 47 μμf, 600 volts, dc			Discriminator Subassembly alinement
27	Capacitor, 0.1 μf, 600 volts, dc			Channelizer Subassembly alinement

Figure 3-1. Test Equipment Required (Sheet 2 of 2)

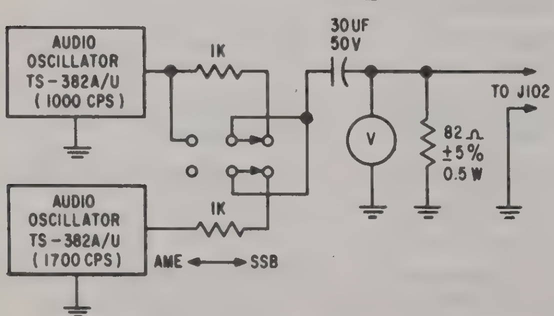


Figure 3-2. Dummy Microphone Schematic Diagram

Part Number	Name
024 2900 00	No. 4 Bristo Wrench
024 9730 00	No. 6 Bristo Wrench
024 0019 00	No. 8 Bristo Wrench
024 9710 00	No. 10 Bristo Wrench

Figure 3-3. Special Maintenance Tools Supplied

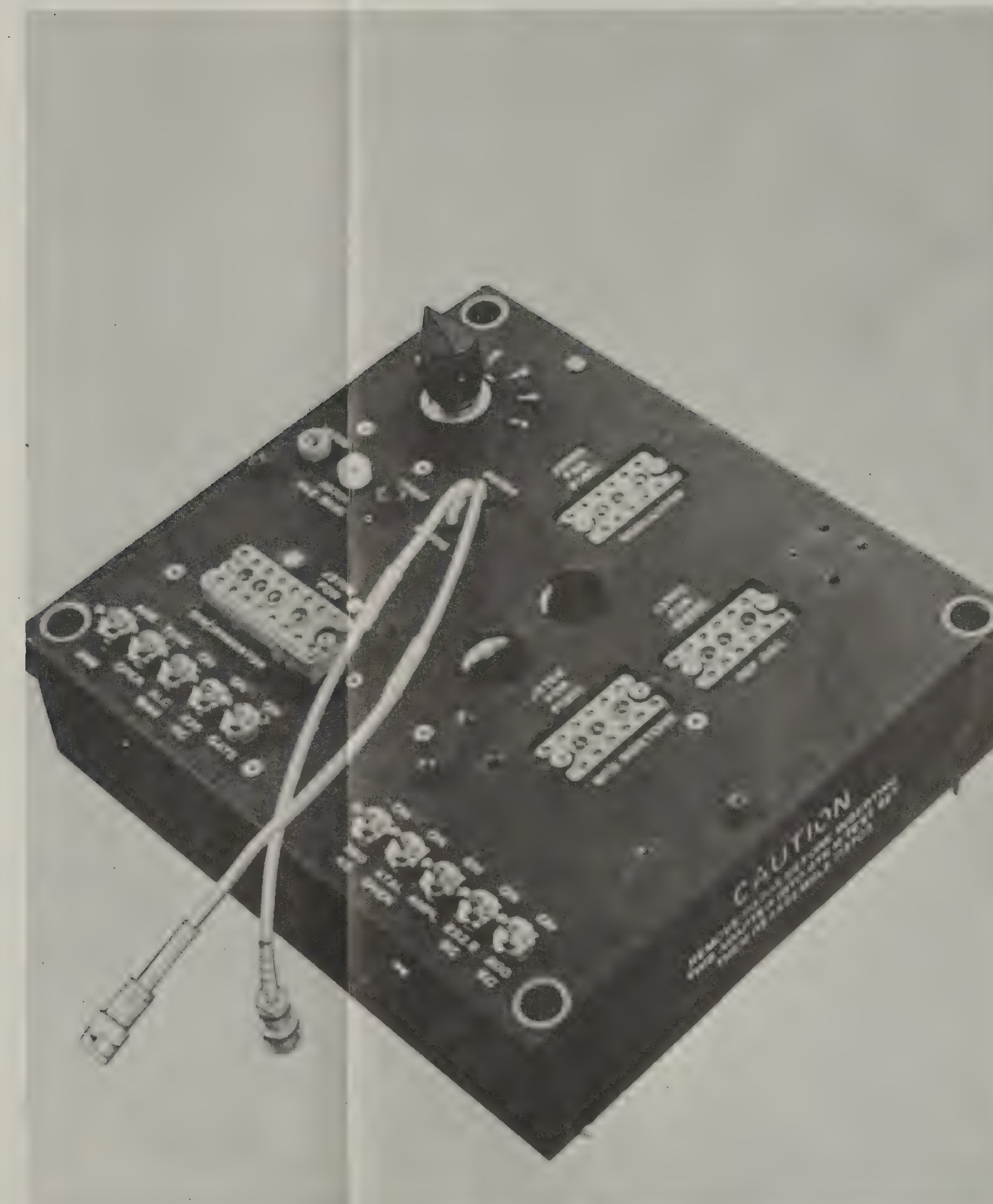


Figure 3–4. Adapter Box for Modified Test Set 478H–1

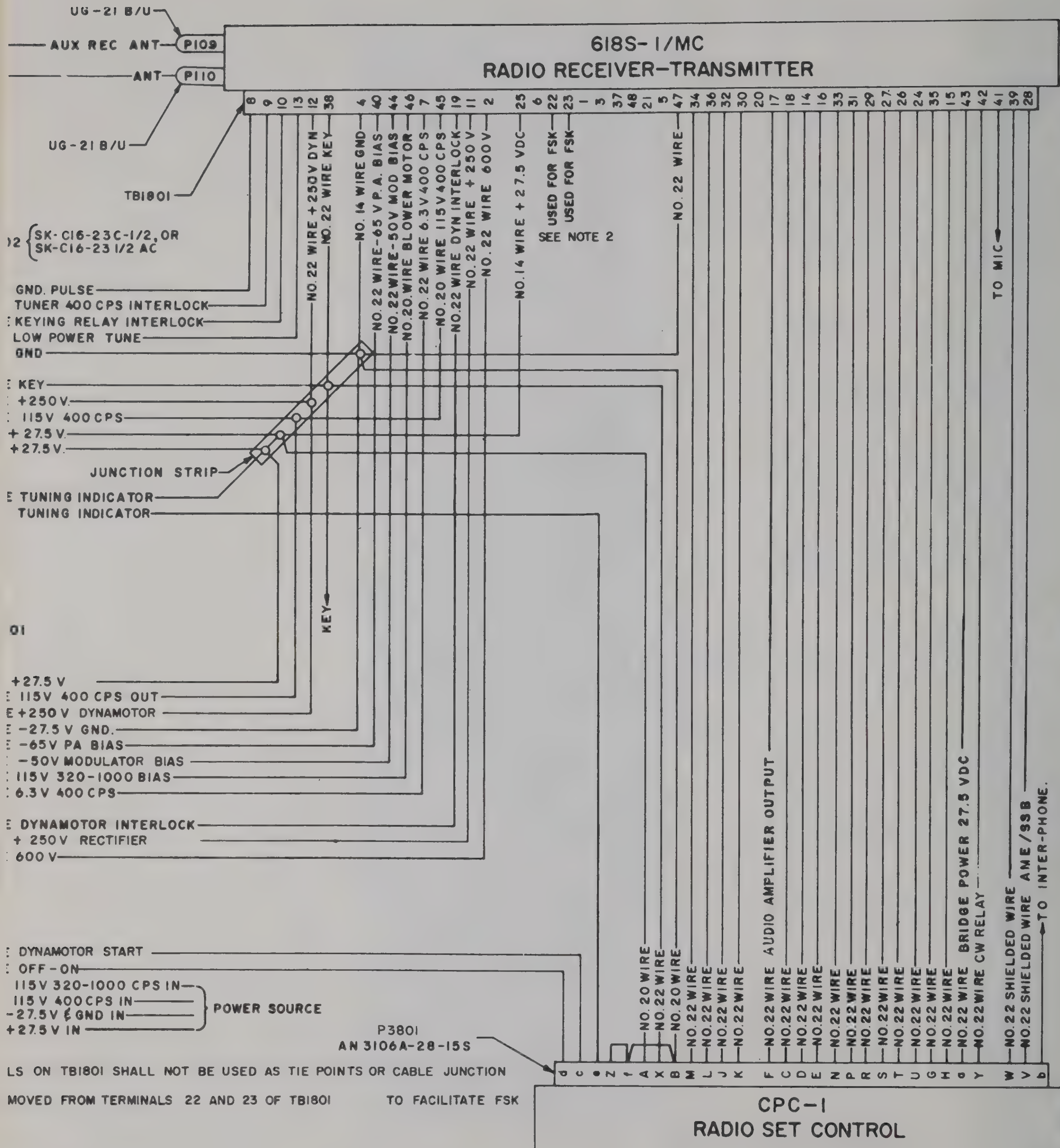
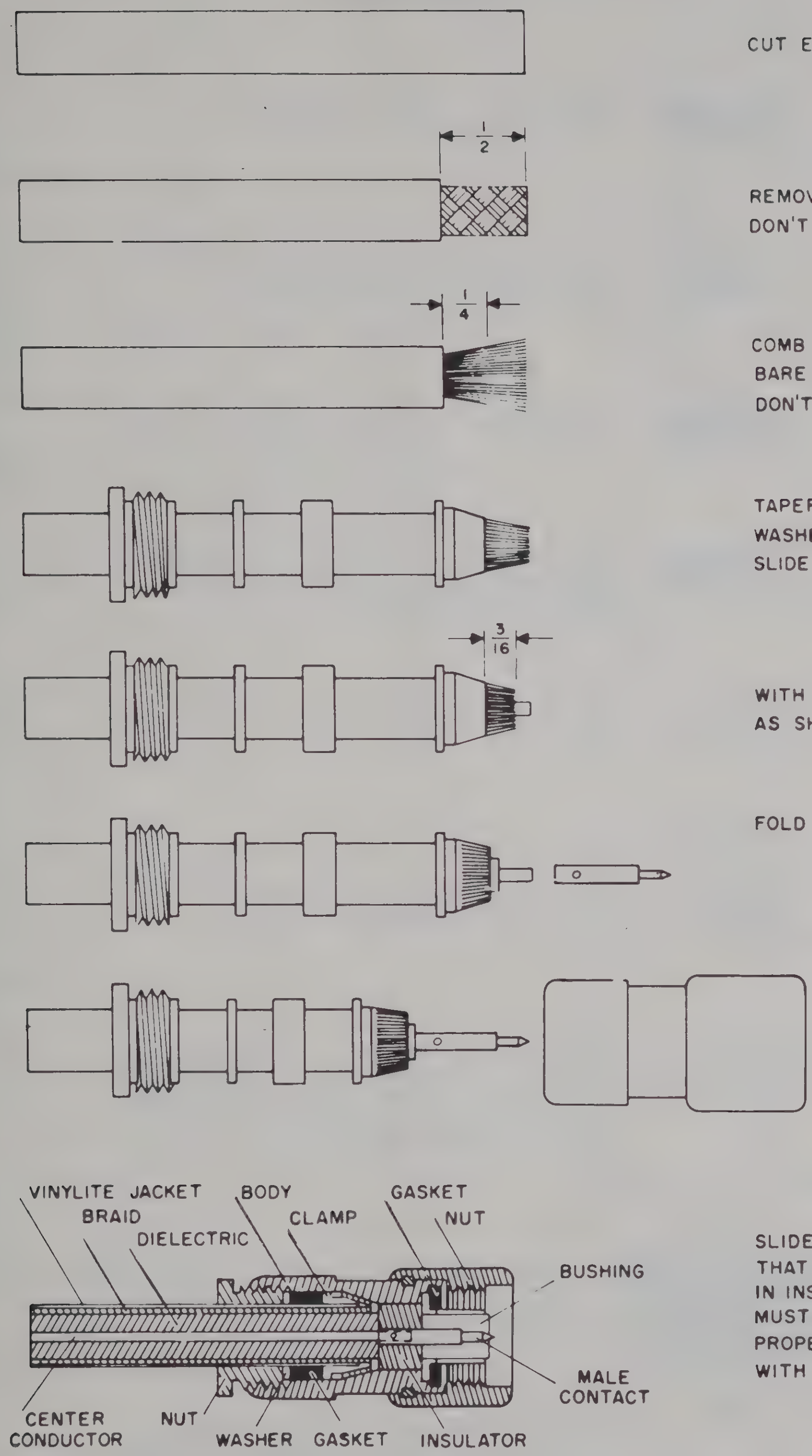


Figure 3–5. Intercomponent Cable Connections



CUT END OF CABLE EVEN.

REMOVE VINYL JACKET $\frac{1}{2}$ INCH — DON'T NICK BRAID.

COMB OUT COPPER BRAID AS SHOWN. BARE $\frac{1}{4}$ INCH OF CENTER CONDUCTOR — DON'T NICK CONDUCTOR.

TAPER BRAID AS SHOWN. SLIDE NUT, WASHER AND GASKET ON VINYL JACKET. SLIDE CLAMP ON BRAID.

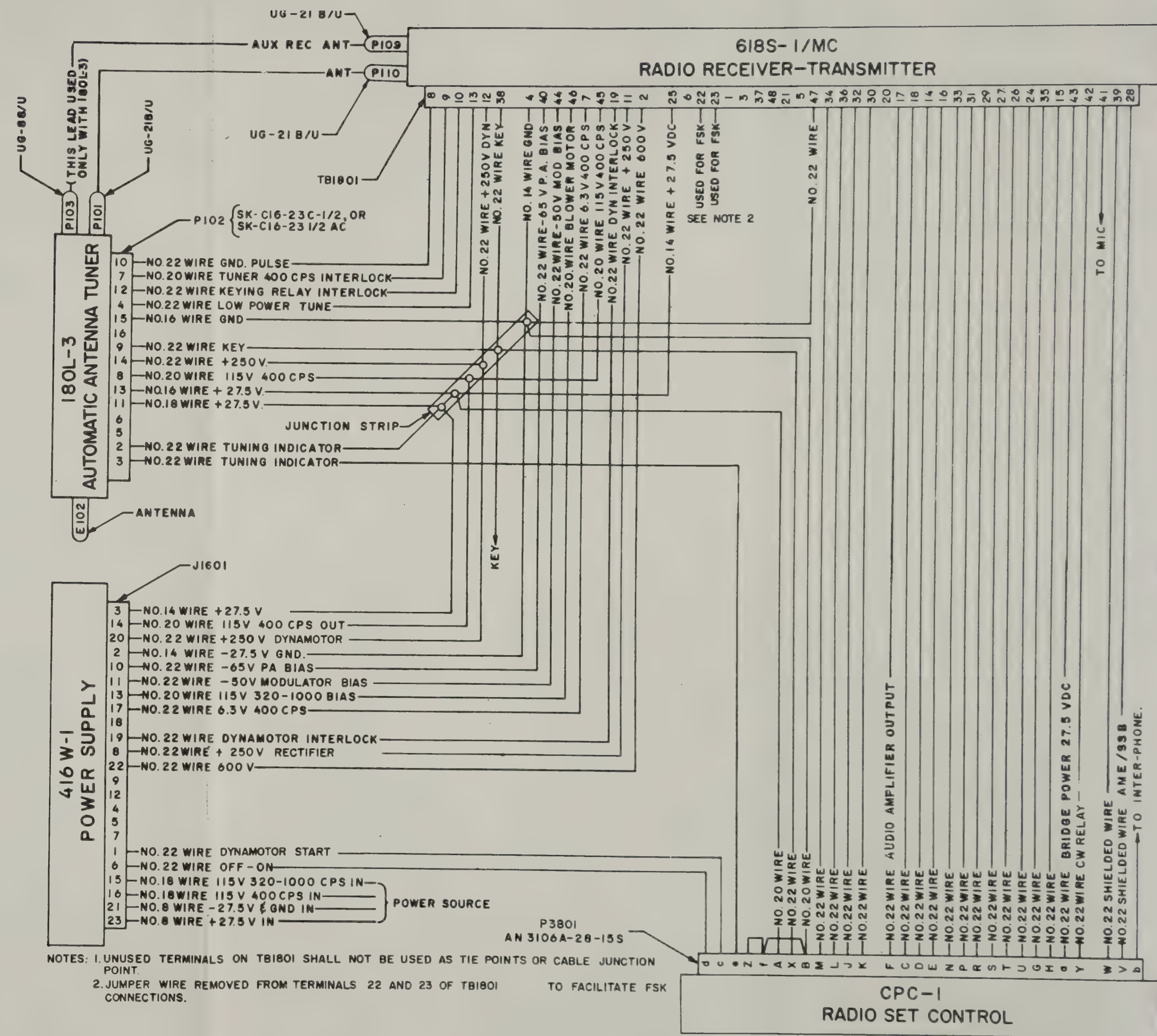
WITH CLAMP IN PLACE, TRIM BRAID AS SHOWN.

FOLD COPPER BRAID BACK ON CLAMP. TIN CENTER CONDUCTOR, USING MINIMUM AMOUNT OF HEAT.

HOLDING CONTACT WITH PLIERS, SOFT SOLDER CONTACT TO CENTER CONDUCTOR. IT IS IMPERATIVE THAT BACK END OF CONTACT BE FLUSH WITH POLYETHYLENE DIELECTRIC. DO NOT USE EXCESS SOLDER. WIPE CLEAN - SEE THAT END OF CABLE INSULATOR IS CLEAN AND FREE OF SOLDER, ROSIN AND FOREIGN MATERIAL.

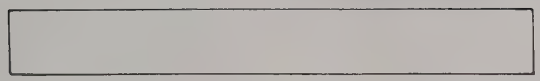
SLIDE BODY INTO PLACE CAREFULLY SO THAT CENTER CONDUCTOR ENTERS HOLE IN INSULATOR. FACE OF CABLE DIELECTRIC MUST FIT FLUSH AGAINST INSULATOR. PROPERLY TIGHTEN BODY AND NUT WITH WRENCHES.

Figure 3–6. Assembly of Connector UG–21B/U to Coaxial Cable

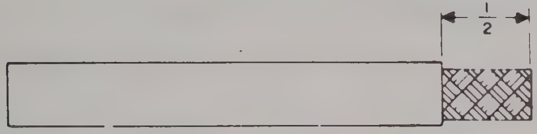


NOTES: 1. UNUSED TERMINALS ON TB1801 SHALL NOT BE USED AS TIE POINTS OR CABLE JUNCTION POINT.
2. JUMPER WIRE REMOVED FROM TERMINALS 22 AND 23 OF TB1801 TO FACILITATE FSK CONNECTIONS.

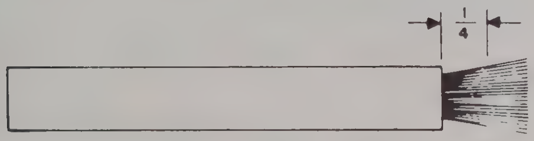
Figure 3–5. Intercomponent Cable Connections



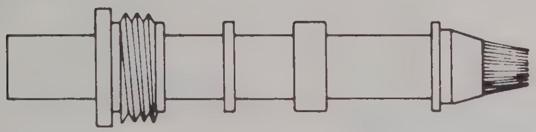
CUT END OF CABLE EVEN.



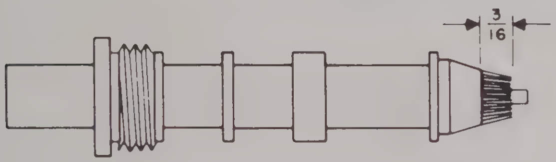
REMOVE VINYL JACKET $\frac{1}{2}$ INCH – DON'T NICK BRAID.



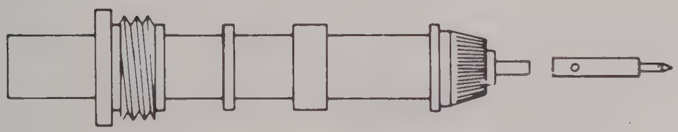
COMB OUT COPPER BRAID AS SHOWN. BARE $\frac{1}{4}$ INCH OF CENTER CONDUCTOR – DON'T NICK CONDUCTOR.



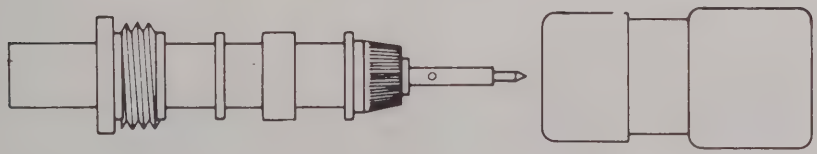
TAPER BRAID AS SHOWN. SLIDE NUT, WASHER AND GASKET ON VINYL JACKET. SLIDE CLAMP ON BRAID.



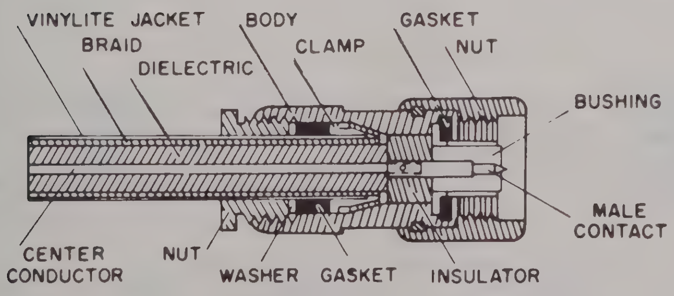
WITH CLAMP IN PLACE, TRIM BRAID AS SHOWN.



FOLD COPPER BRAID BACK ON CLAMP. TIN CENTER CONDUCTOR, USING MINIMUM AMOUNT OF HEAT.



HOLDING CONTACT WITH PLIERS, SOFT SOLDER CONTACT TO CENTER CONDUCTOR. IT IS IMPERATIVE THAT BACK END OF CONTACT BE FLUSH WITH POLYETHYLENE DIELECTRIC. DO NOT USE EXCESS SOLDER. WIPE CLEAN – SEE THAT END OF CABLE INSULATOR IS CLEAN AND FREE OF SOLDER, ROSIN AND FOREIGN MATERIAL.



SLIDE BODY INTO PLACE CAREFULLY SO THAT CENTER CONDUCTOR ENTERS HOLE IN INSULATOR. FACE OF CABLE DIELECTRIC MUST FIT FLUSH AGAINST INSULATOR. PROPERLY TIGHTEN BODY AND NUT WITH WRENCHES.

Figure 3–6. Assembly of Connector UG–21B/U to Coaxial Cable

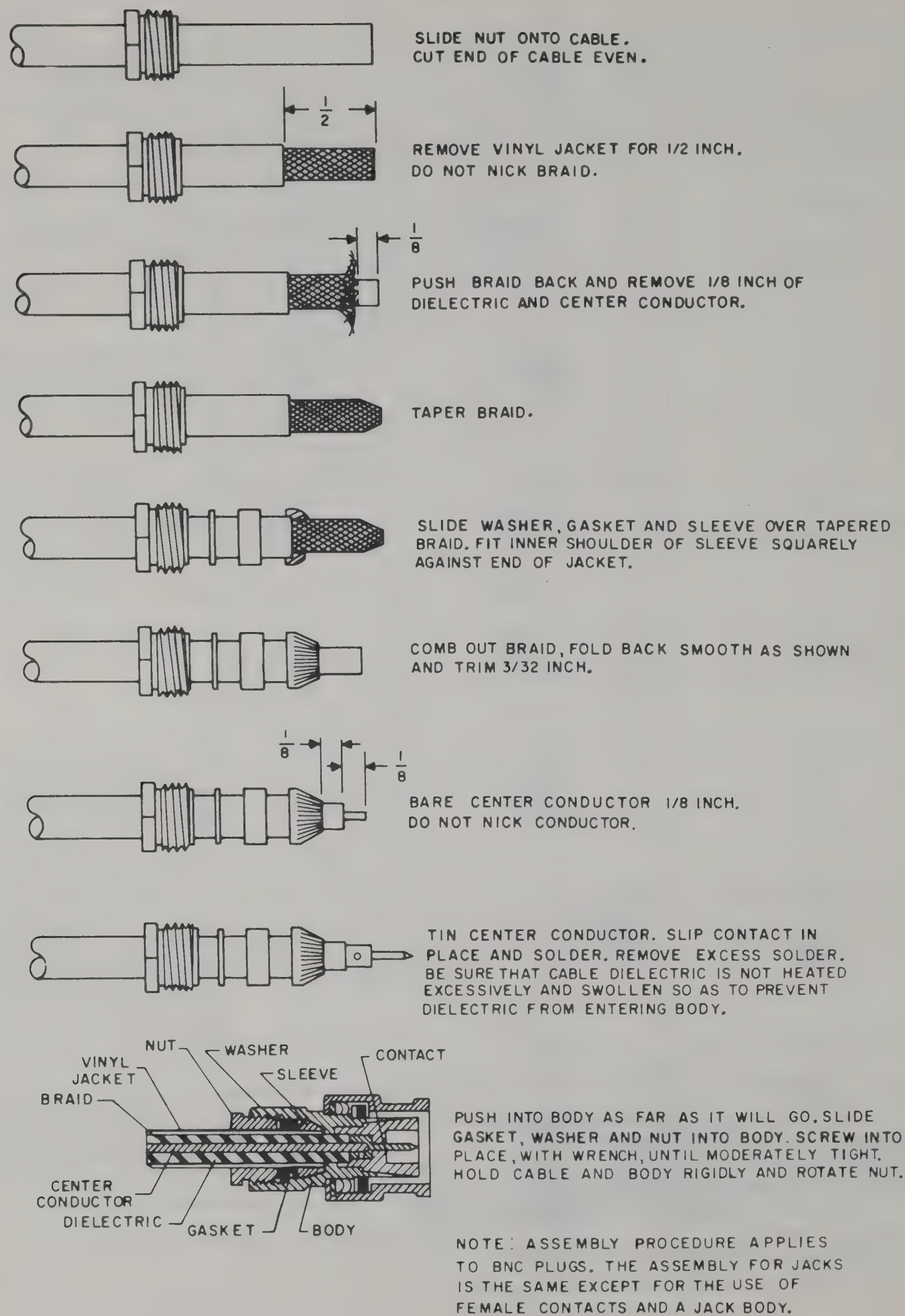


Figure 3-7. Assembly of Connector UG-88/U to Coaxial Cable

Figure and Item No.	Description	Max. No. Required	Use and Application
1 (Fig. 3-9)	20-terminal extension cable with two plugs	8	Provides power and control connections between the receiver-transmitter chassis and the channelizer, tuner, power amplifier, i-f amplifier, or front panel subassemblies; also, provides for connection of discriminator subassembly to channelizer subassembly
2 (Fig. 3–10)	15-terminal extension cable with two plugs	8	Provides power and control connections between the receiver-transmitter chassis and bfo sidetone gate, modulator, tuner servo amplifier, relay, reference oscillator, and front panel subassemblies
3 (Fig. 3–11)	11-terminal extension cable with two plugs	1	Provides power and control connections between the receiver-transmitter chassis and audio amplifier subassembly.
4 (Fig. 3–11)	9-terminal extension cable with two plugs	1	Provides power and control connections between the front panel subassembly and the bandchange Autopositioner unit
5 (Not Illustrated)	7-terminal extension cable with two plugs (requires one each American Phenolic Type 26-191 and 26–192 receptacles; seven 2-foot lengths of HA wire, Fabrication same as for 9-terminal extension cable)	3	Provides power and control connections between the front panel subassembly and the "PHONE, MIC, KEY" jacks, servo-motor B102, meter selector switch, and blower motor B101 units

Figure 3–8. Special Cables Required for Maintenance Procedures

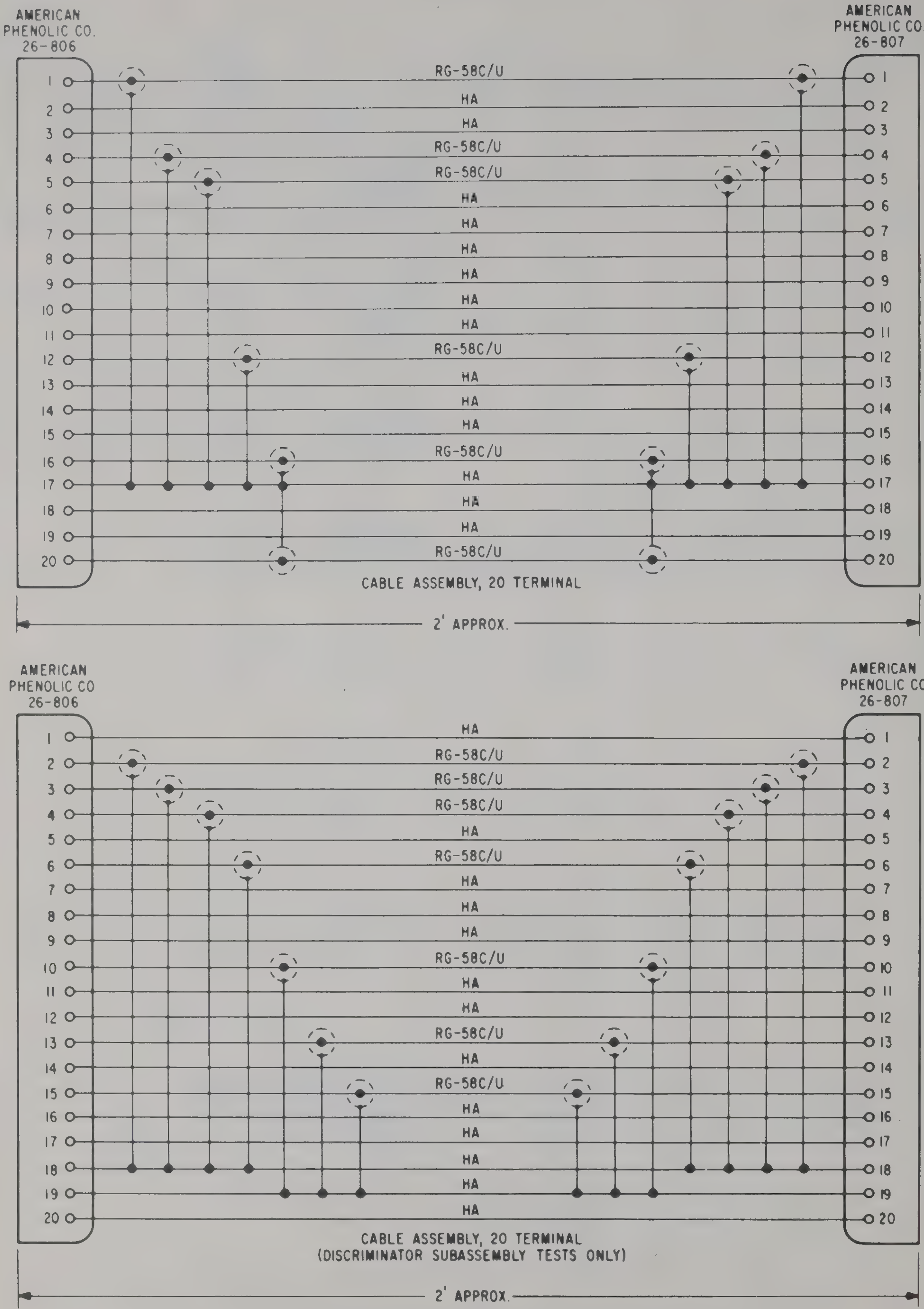
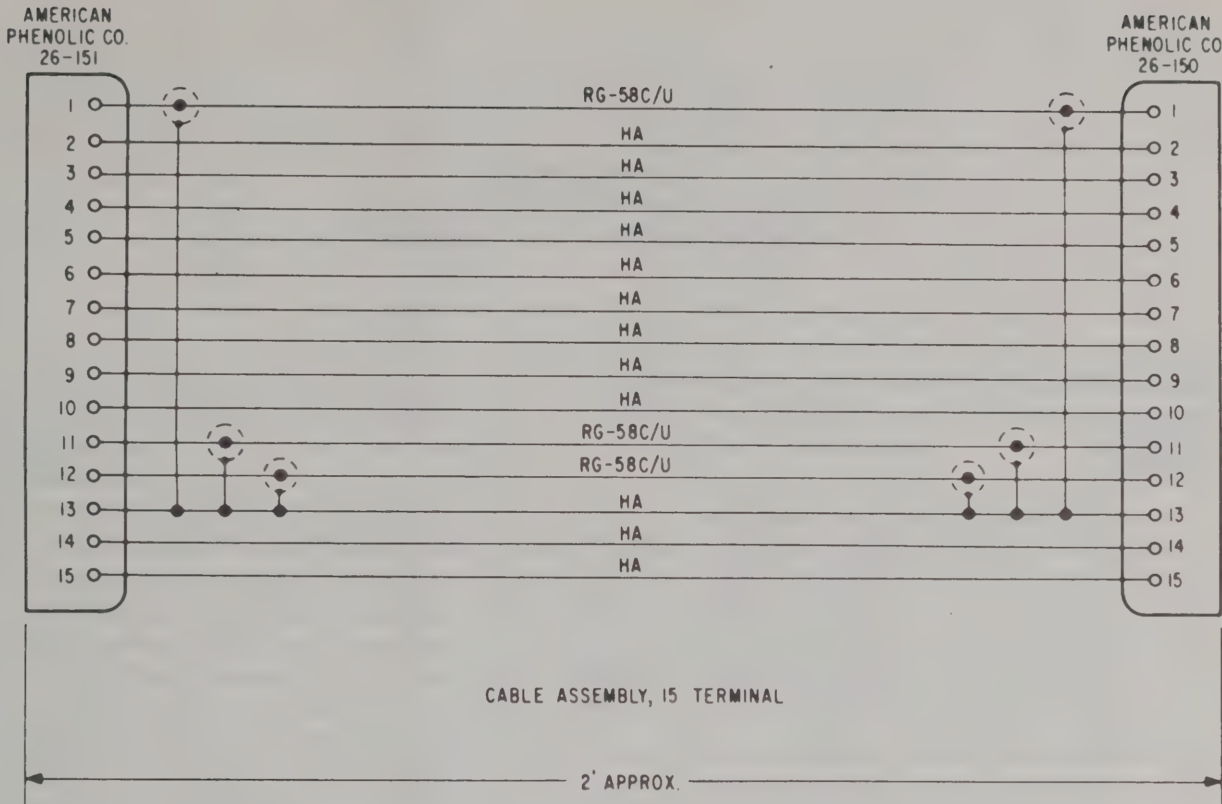


Figure 3–9. Typical Cable Assembly (20 Terminal)



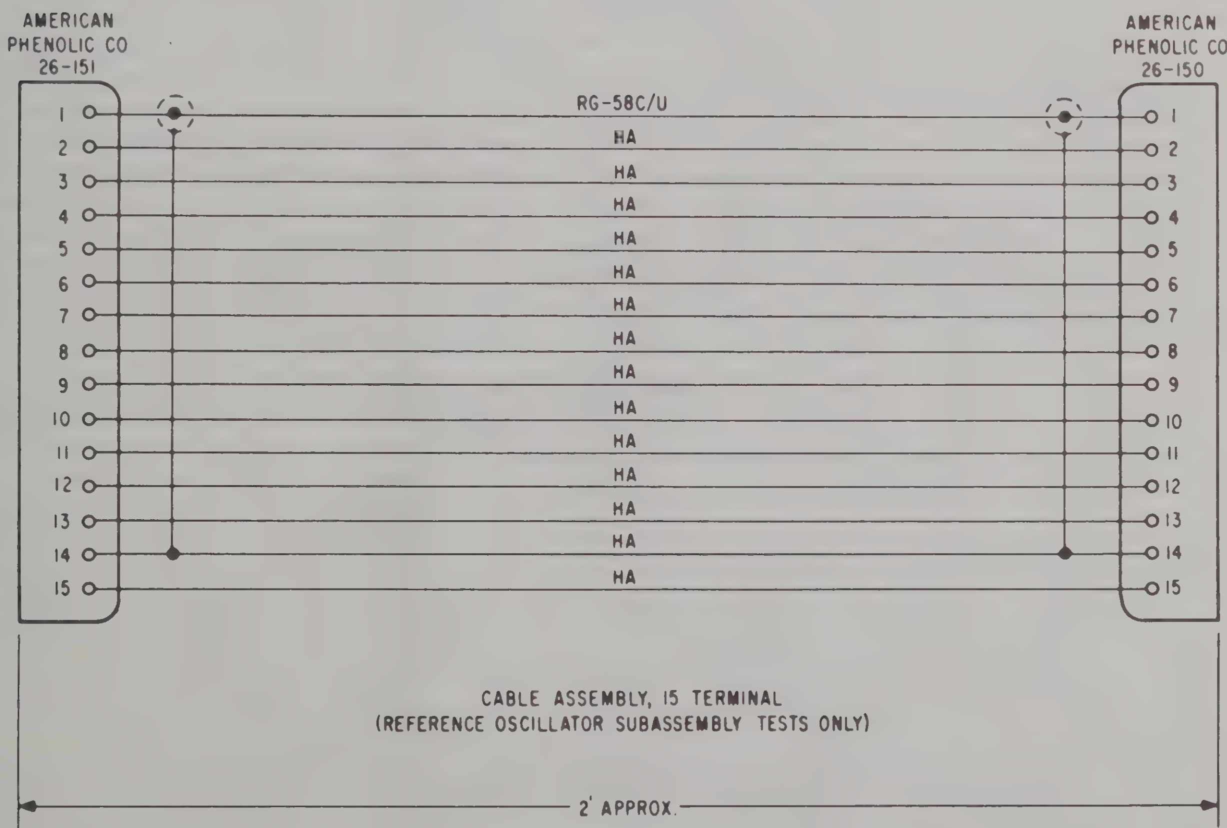


Figure 3–10. Typical Cable Assembly (15 Terminal)

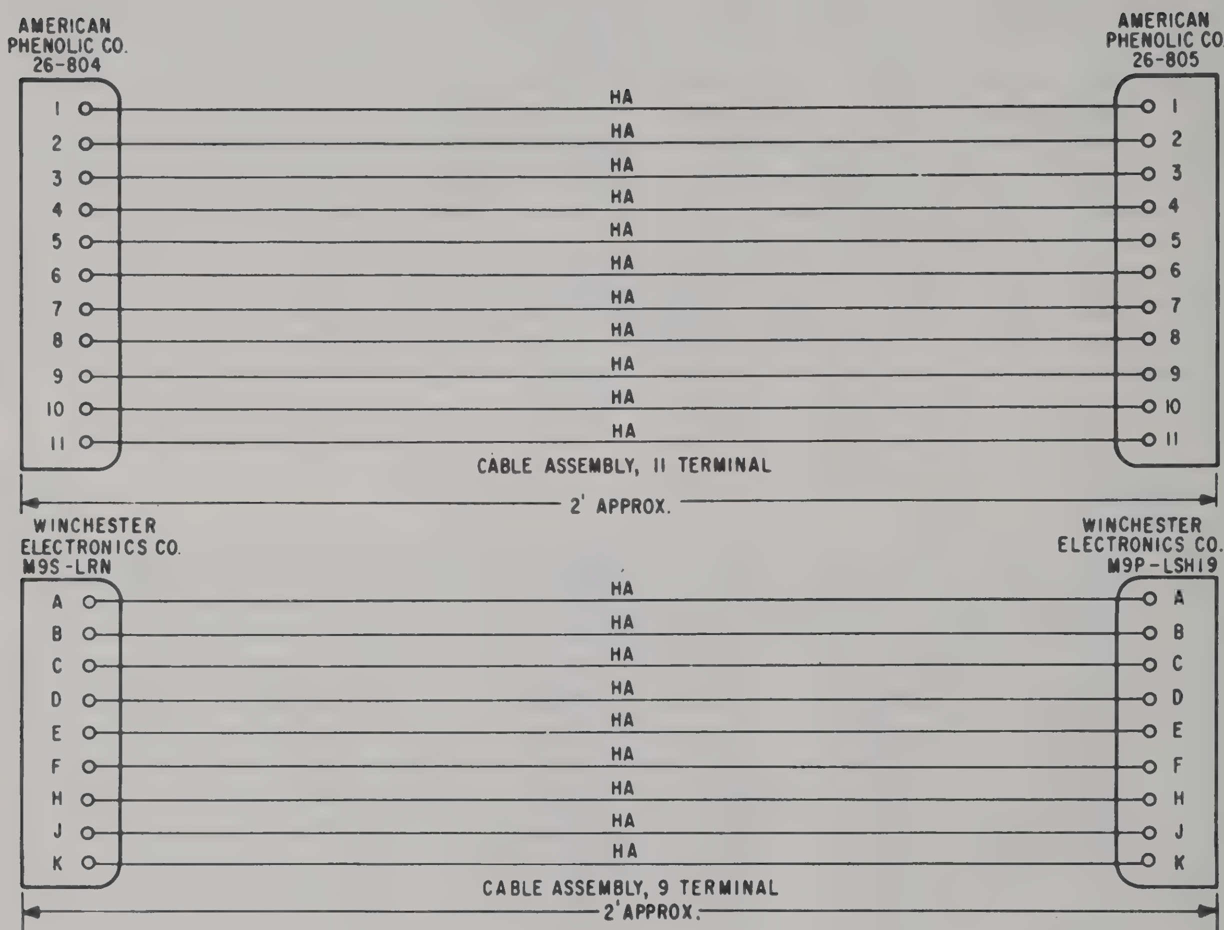


Figure 3–11. Typical Cable Assembly (9 and 11 Terminal)

SECTION IV
THEORY OF OPERATION

4–1. GENERAL.

4–2. This section contains a concise explanation of the theory of operation of Radio Set 618S–1/MC. An explanation of the symbols used for test point identification are also included.

4–3. TEST POINT IDENTIFICATION SYMBOLS.

4–4. A system of test point identification symbols is incorporated on schematic diagrams, tables, charts, and illustrations to indicate voltage, continuity, and signal tracing points used while performing the bench test in Section III, the system analysis in Section VI, and the maintenance procedures described in Sections VII through IX. Major test points are designated by a star-encircled Arabic numeral and are used mainly to localize trouble in the system to a component or other assembly, or subassembly. Secondary test points appear as an encircled capital letter and are used to isolate trouble in a component to an assembly or subassembly. Secondary test points are assigned on a component basis. Minor test points are represented by an encircled capital letter and an Arabic numeral combination and are assigned to subassemblies. All minor test points within a subassembly use the same capital letter and may represent a point to test voltage, inject a signal, measure gain, or any other function in order to localize trouble to a stage or within a stage. Certain test points and jacks are identified by stencilling on the equipment of "TP" and "J" (or "P") symbol numbers which are also shown on the schematic diagrams. As these test points are readily identified, no other test point symbols are assigned. All stencilled test points will be listed in the trouble analysis tables as they appear on the individual subassemblies and schematic diagrams.

4–5. RADIO SET 618S–1/MC FUNCTIONAL OPERATION.

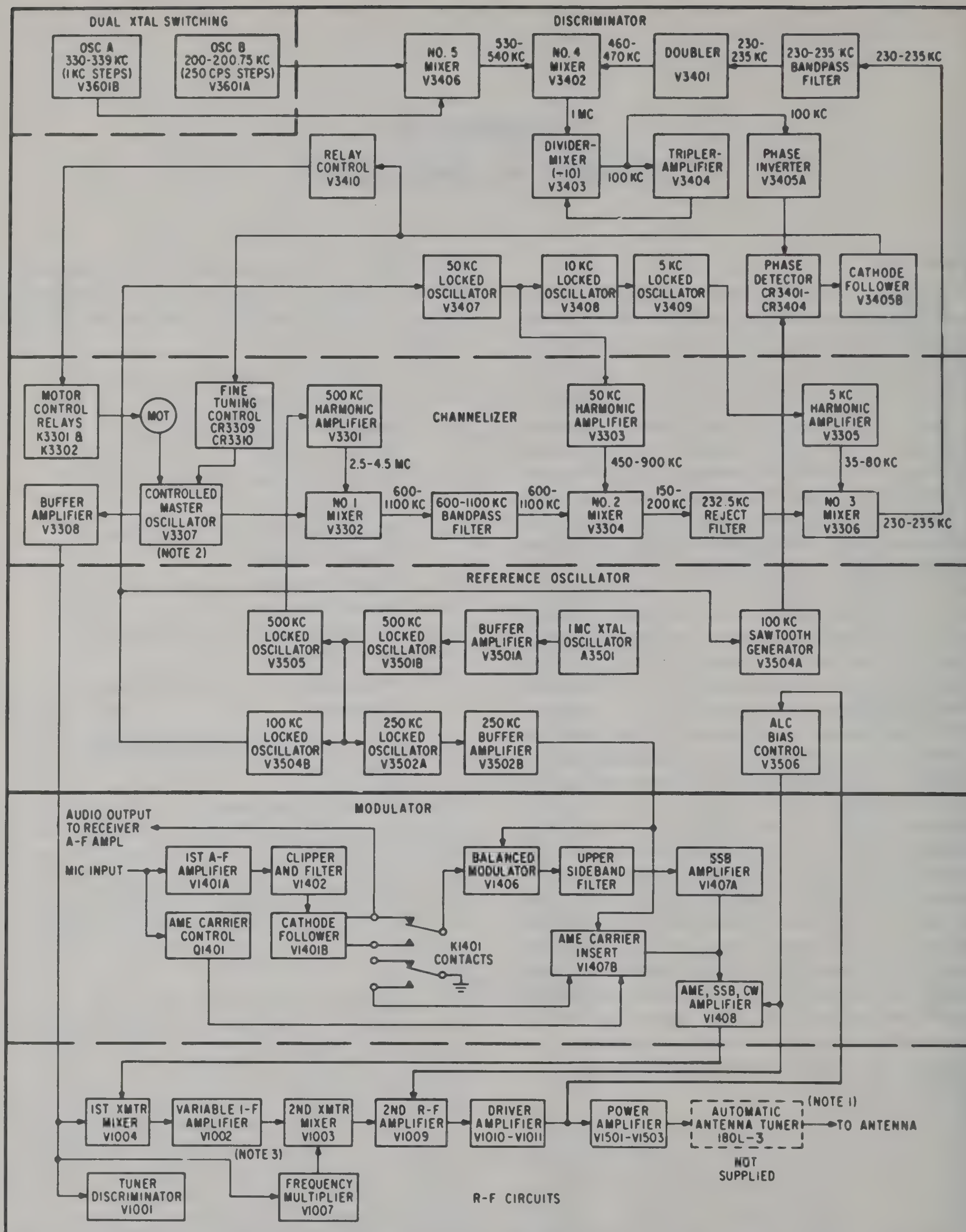
4–6. GENERAL. Radio Set 618S–1/MC comprises the necessary components to provide operation both as a transmitter and a receiver. Radio Receiver-Transmitter 618S–1/MC is the major component in the system. Matching between the receiver-transmitter antenna output and the antenna is accomplished automatically by use of the Automatic Antenna Tuner 180L–3 (not supplied). All control of the equipment is provided by means of Radio Set Control CPC–1. Power for operation of the radio set is provided by the power sources in the aircraft and Power Supply 416W–1.

4–7. INDEX TO DIAGRAMS. The following diagrams are used in this section for purposes of explaining the functional operation of the various components provided with the radio set.

4–8. RADIO RECEIVER-TRANSMITTER 618S–1/MC

4–9. GENERAL. The functional theory of operation of the receiver-transmitter can be divided into three general descriptions, the control section, the transmitter section, and the receiver section. The explanation to follow will, in general, be divided accordingly. However, since many of the operating functions are interdependent, a certain amount of overlap will be required.

4–10. TRANSMITTER SECTION. The receiver-transmitter consists of a number of plug-in subassemblies such as the channelizer, discriminator, dual crystal switching, reference oscillator, and modulator subassemblies (see figure 4–1). The channelizer, operating in conjunction with the discriminator, dual crystal switching, and reference oscillator subassemblies, determines the output frequency of the controlled master oscillator (V3307). The cmo is located in the channelizer subassembly along with the low level tuning drive motor and associated control circuits. Tuning of the cmo is accomplished by comparing the resultant 100–kc output of various heterodyned frequencies derived from the output of the cmo, the dual crystal oscillators (V3601A and B) and three harmonic amplifiers (V3301, V3303, and V3305), with the sawtooth output of a 100–kc signal derived from a 1–mc crystal



NOTE 1: OUTPUT FREQUENCIES
BAND 1. 2-3.7495 MC
BAND 2. 3.75-7.2495 MC
BAND 3: 7.250-14.2495 MC
BAND 4. 14.250-25.0 MC

NOTE 2: CMO OUTPUT FREQUENCIES
BAND 1: 1.75-3.4995 MC
BAND 2: 1.75-3.49975 MC
BAND 3: 1.75-3.499875 MC
BAND 4: 1.75-3.09375 MC

NOTE 3. VARIABLE I-F FREQUENCIES
BAND 1: 2-3.7495 MC
BAND 2. 2-3.74975 MC
BAND 3: 2-3.749875 MC
BAND 4. 2-3.34375 MC

Figure 4–1. Transmitter Circuits, Functional Block Diagram

controlled reference standard (A3501). Comparison of the two 100-kc signals is accomplished in a phase detector (CR3401 through CR3404) and the resultant difference voltage coupled through a cathode follower (V3405B) to a relay control stage (V3410). The relay control stage actuates relays which in turn control the rotation of the tuning mechanism drive motor (MOT) which tunes the cmo to the selected fundamental frequency. The voltage from V3405B is also applied to the variable-capacity diodes CR3309 and CR3310. Any change in the voltage at the cathode of V3405B will result in a change in the shunt capacitance of the fine tuning control diodes and produce a phase lock with the reference standard corresponding to the exact frequency selected.

4-11. Frequencies of 500-kc and 250-kc also are derived from the 1-mc reference standard (A3501) located in the reference oscillator subassembly. The output of A3501 drives a 1-mc buffer amplifier (V3501A) which in turn drives a 500-kc locked oscillator (V3501B). The output of V3501B is coupled to a 500-kc cathode follower (V3505A), a 250-kc locked oscillator (V3502A) and a 100-kc locked oscillator (V3504B). The output of V3505A is coupled to a second 500-kc cathode follower (V3505B). The output of V3505B is used to drive the 500-kc harmonic amplifier stage (V3301), which has an output range of 2.5 to 4.5 mc. The 100-kc locked oscillator V3504B is coupled to a 100-kc sawtooth generator (V3504A) and to a 50-kc locked oscillator (V3407A). The output of V3407A is coupled to a 10-kc locked oscillator (V3408A) and to a 50-kc cathode follower (V3407B), which in turn drives the 50-kc harmonic amplifier stage (V3303), which has an output range of 450 to 900-kc. The 10-kc locked oscillator V3408A drives a 5-kc locked oscillator (V3409A) which in turn drives a 5-kc cathode follower (V3409B)). The output of V3409B drives the 5-kc harmonic amplifier (V3305), which has an output range of 35 to 80 kc. The selected harmonic of the 500-kc harmonic amplifier V3301 is combined in the first mixer (V3302) with the varying frequency output of the cmo (V3307) to provide a difference frequency within the range of 600 to 1100 kc. This output is combined in the second mixer (V3304) with the selected harmonic of the 50-kc harmonic amplifier V3303 to provide a difference frequency within the range of 150 to 200 kc. This output is combined in the third mixer (V3306) with the selected harmonic of the 5-kc harmonic amplifier V3305 to provide a sum frequency output within the range of 230 to 235-kc. This output is coupled to the doubler (V3401) which produces a frequency in the range of 460 to 470 kc. The doubler output is combined in the fourth mixer (V3402) with the output of the fifth mixer (V3406). Frequencies within the range of 330 to 339 kc are supplied in 1-kc steps by the A oscillator (V3601B) and within the range of 200 to 200.75 kc in 250 cps steps by the B oscillator (V3601A) to the fifth mixer V3406. These frequencies are supplied by individual crystals located in the dual crystal oscillator subassembly producing a sum output in the range of 530 to 539. 75 kc in 250-cps steps from the fifth mixer V3406. The sum of the fourth mixer input signals provides a 1-mc output which is divided by 10 in the regenerative divided-mixer stage (V3403 and V3404). The 100-kc output of V3404 is coupled through the phase inverter stage (V3405A) to the phase detector where it is compared with the 100-kc sawtooth output of V3504A to provide the difference voltage at the cathode of V3405B. Fine tuning of the cmo is then accomplished as described previously.

4-12. MODULATOR. The voice signals from the microphone are amplified by V1401A and coupled through a clipper stage V1402 and a filter network to V1401B. The clipper stage prevents overmodulation of the transmitter and the filter network will attenuate all frequencies above 5000 cps. This is required as the clipping action of V1402 will generate high-frequency distortion products. The output of the filter is connected to the cathode follower stage V1401B which has its cathode load resistance split into two equal sections in order to obtain the correct audio levels at the input of the balanced modulator stage V1406. In the ame mode of operation the audio signal must be reduced to one-half the ssb value in order to keep the peak r-f signal at the same amplitude. This reduction is necessary because one-half of the ame signal is composed of r-f carrier. The switching function for the two audio levels is accomplished by means of one set of contacts on relay K1401. This relay is actuated when choosing the ame mode of operation at the radio set control.

4-13. The cathode follower also supplies an audio signal for the sidetone circuit. The voice signals appearing across the cathode are coupled to the receiver audio amplifier through a r-f controlled gate relay located in the bfo and sidetone gate subassembly (see paragraph 7-246).

4-14. When operating in the single sideband mode, the fundamental frequencies (generated in the cmo) supplied to the first transmitter mixer, V1004 are mixed with the upper sideband modulation generated in the balanced modulator stage. Two signals are coupled into V1406. One is the audio signal from the cathode of V1401B, and the other a 250-kc signal from the buffer amplifier V3502B. This signal is generated by the 250-kc locked oscillator V3502A and is derived by means of frequency division from the 1-mc reference standard crystal. When V1406 is properly balanced, the 250-kc component will be sharply attenuated and the output signal will consist almost entirely of the upper and lower sideband components. As only the upper sideband is required, the lower sideband is eliminated by means of the upper sideband filter. The modulated upper sideband output of the filter is then amplified by V1407A and V1408.

4–15. As the input drive will vary with the amplitude of the operating frequencies, the modulation level is held constant automatically by applying a varying bias from the rectified output of the alc bias control stage V3506. Input voltage for driving V3506 is obtained from the grid circuit of the power amplifier stage in the transmitter. Therefore, any change in the amplitude of the signal driving the power amplifiers will cause a corresponding change in the conduction of V3506. The resultant change in output voltage from V3506 is then converted into a d-c bias which is connected to the grids of V1408 and V1009 to control the stage gain.

4–16. When operating in the cw or ame mode, it is necessary to provide a means of transmission which can be received on a conventional AM. receiver. This is accomplished in V1408 by combining the 250-kc carrier signal with the single sideband signal in the proper ratio. This ratio is one-half the 250-kc signal to one-half the single sideband signal. Reduction of the amplitude of the single sideband signal is accomplished by means of one set of contacts on K1401 which connects one-half of the audio signal appearing across the cathode of V1401B to the balanced modulator input. Simultaneously, a second set of contacts on K1401 operate to cause the ame carrier insert tube V1407B to conduct. This permits the 250-kc signal from V3502B to pass through V1407B and mix with the single sideband signal from V1407A in V1408.

4–17. As the automatic level control circuit supplies bias to V1408 only when the transmitter is being modulated, it is necessary to attenuate the 250-kc portion of the ame signal when the transmitter is keyed (unmodulated). This is accomplished by self-biasing V1407B to cutoff so only a very small amount of carrier signal will be passed to V1408. When modulation is present, the ame carrier control circuit (Q1401) produces a positive bias voltage which is applied to the grid of V1407B. This increases the conduction through V1407B sufficiently to supply the required carrier level for ame operation.

4–18. The ame carrier injection circuit must also be capable of complete cutoff when operating in the ssb mode, or the 250-kc carrier will leak through and degrade the transmission. Therefore, the contacts of K1401 operate to open the ground return circuit to the V1407B stage. This action prevents V1407B from conducting.

4–19. R-F CIRCUITS. The output of V1408 is applied to the first transmitter mixer V1004 where it is combined with the output of the buffer amplifier V3308. Further amplification and frequency multiplication is then achieved by means of the variable i-f amplifier V1002, second transmitter mixer V1003, frequency multiplier V1007, second r-f amplifier V1009, the parallel connected driver amplifiers V1010 and V1011, and the parallel connected power amplifiers V1501, V1502, and V1503. Notes 1 through 3 of figure 4–1 show the range of output frequencies appearing at the outputs of the cmo, variable i-f amplifier, and the antenna.

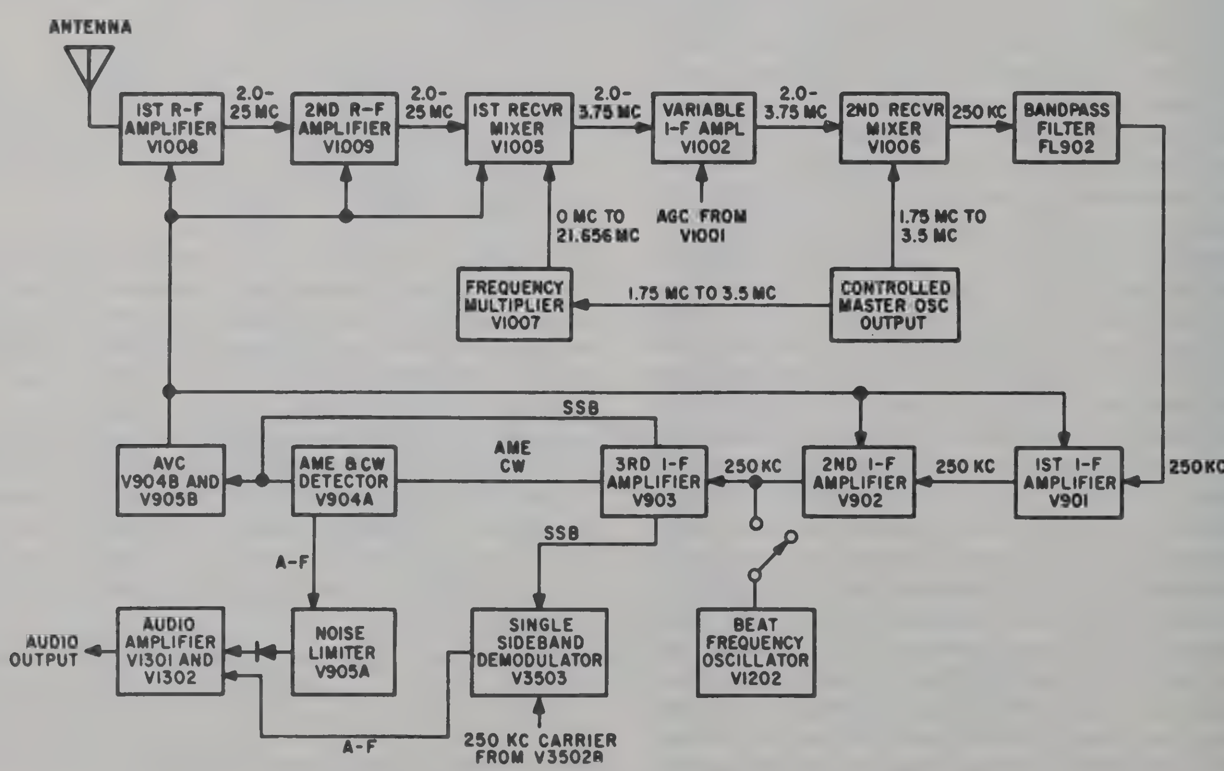


Figure 4–2. Receiver Circuits, Functional Block Diagram

4–20. RECEIVER SECTION (See figure 4–2). Any r-f signal within the range of 2 to 25 mc is amplified by the first and second r-f amplifiers, V1008 and V1009, respectively. The r-f signal is then mixed in the first receiver mixer, V1005 with the selected multiplier frequency from V1007. When operating in band 1, the output frequency of V1007 is zero. In band 2, the output frequency is within the range of 1.75 to 3.5MHZ. In bands 3 and 4, the output frequencies are within the ranges of 5.25 to 10.5 mc, and 12.25 to 21.65 mc, respectively. The difference frequency from V1005 (within the range of 2 to 3.75 mc) is then amplified in the variable i-f amplifier V1002 and combined with the selected frequency from the cmo to obtain a second intermediate frequency of 250 kc. After passing through the bandpass filter, the 250 kc is amplified by the first, second, and third i-f amplifiers, V901, V902, and V903, respectively. The output of the bfo, V1202 is injected into the input of V903 when operating in the cw mode only.

4–21. When operating in the ame and cw modes, the output of V903 is coupled to the AM. detector, V904A. Noise peaks of short duration which may be present on the audio signal are limited in their amplitude by means of the series limiter stage V905A. The remaining audio signal is then amplified by the audio amplifier stages V1301 and V1302 for reproduction in the headset or aircraft intercom.

4–22. When operating in the ssb mode, the signal from V903 is connected to the input of the product detector V3503. This stage is required as the r-f signal appearing at the output of V903 consists of suppressed carrier upper sideband modulation only. In order to detect this type of signal, it is necessary to reinsert the carrier. This is accomplished by injecting the 250–kc signal (generated in the reference oscillator subassembly) into V3503. Combination of the r-f modulation and the 250–kc carrier frequency results in demodulation of the r-f signal, and the audio signal appearing in the plate circuit of V3503 will be amplified and reproduced in the headset as described previously.

4–23. Negative bias for automatic control of the amplification of the first and second r-f amplifiers, first and second receiver mixers, and the first and second i-f amplifiers is obtained from the avc stage consisting of V904B and V905B. The agc voltage for control of the amplification of the variable i-f amplifier is obtained from a discriminator network in the r-f tuner subassembly.

4–24. CONTROL SECTION. The control section of the radio set includes Radio Set Control CPC–1, Automatic Antenna Tuner 180L–3, and circuits contained in the channelizer, dual crystal switching, discriminator, reference oscillator, tuner, power amplifier, and servo subassemblies within the receiver-transmitter. The following functional description will describe the operation of the control circuits with the exception of those in the antenna tuner which are outlined in the applicable service manual.

4–25. Channeling a new frequency consists primarily of completing circuits to ground. It will be noted in figure 4–3, that when the thousands, tens, or units switches on Radio Set Control CPC–1 are operated to different positions, ground is applied through the positioning of the switches S3305A, S3303A, and S3304 to the clutch solenoids L3301, L3303, and L304. The common ends of the clutch solenoids are connected in series with the coil of relay K3305, the thermal control S3306, and +27.5 volts d-c. The hundreds selector switch (S3802A) in the radio set control selects a tap on a resistance network that is connected to ground at one end and to 27.5 volts d-c at the other end. A similar network is controlled by the switch S3302A in the channelizer subassembly. These two resistance networks form a bridge circuit with the coil of K3304 connected in series with the arms of the two switches. When S3802A is changed to a new position, the bridge becomes unbalanced and current flows through the coil of K3304 which energizes the relay, causing the contacts to close. This action completes a ground circuit to the clutch solenoid L3302. Therefore, when any one or combination of solenoids are energized, the resultant current flow through the coil of K3305 will cause its contacts to complete the ground circuit to the coil of K3301, energizing the latter. One set of contacts on K3301, connects 27.5 volts d-c to the motor which drives the shafts of the various switch banks until an open circuit to ground is reached. This condition is met when the switch section controlling the respective clutch solenoid opens the latter circuit to ground. When all clutch solenoids are disconnected from ground by means of the respective switch rotation, the relay K3305 is deenergized causing the motor control relay K3301 to become deenergized.

4–26. Fine tuning of the cmo is accomplished by means of the fine tuning control tube V3410 located in the discriminator subassembly. This stage obtains grid driving voltage from the cathode of the cathode follower output stage (V3405B) of the phase discriminator. When an out of phase condition exists in the phase discriminator, the voltage at the grid of V3410 will lower conduction of the tube causing the relay K3302 to become deenergized. When this occurs, the opening contacts on K3302 completes the ground circuit to the coil of K3301. This energizes the latter and reconnects the motor to 27.5 volts d-c. The motor will operate to tune the cmo capacitor (C33021) to the exact frequency selected. When properly resonated, the resultant potential at the cathode of V3405 will cause V3410 to conduct and hold K3302 in an energized state until a change occurs in the resonance of the circuit.

4–27. Selection of the desired output frequencies of the dual crystal oscillator subassembly is accomplished by completing the ground circuit to two relays. A section on the switch S3803A closes the ground circuit to K3602. This relay is a four-pole-double-throw type. Each of the poles is connected to one of the four

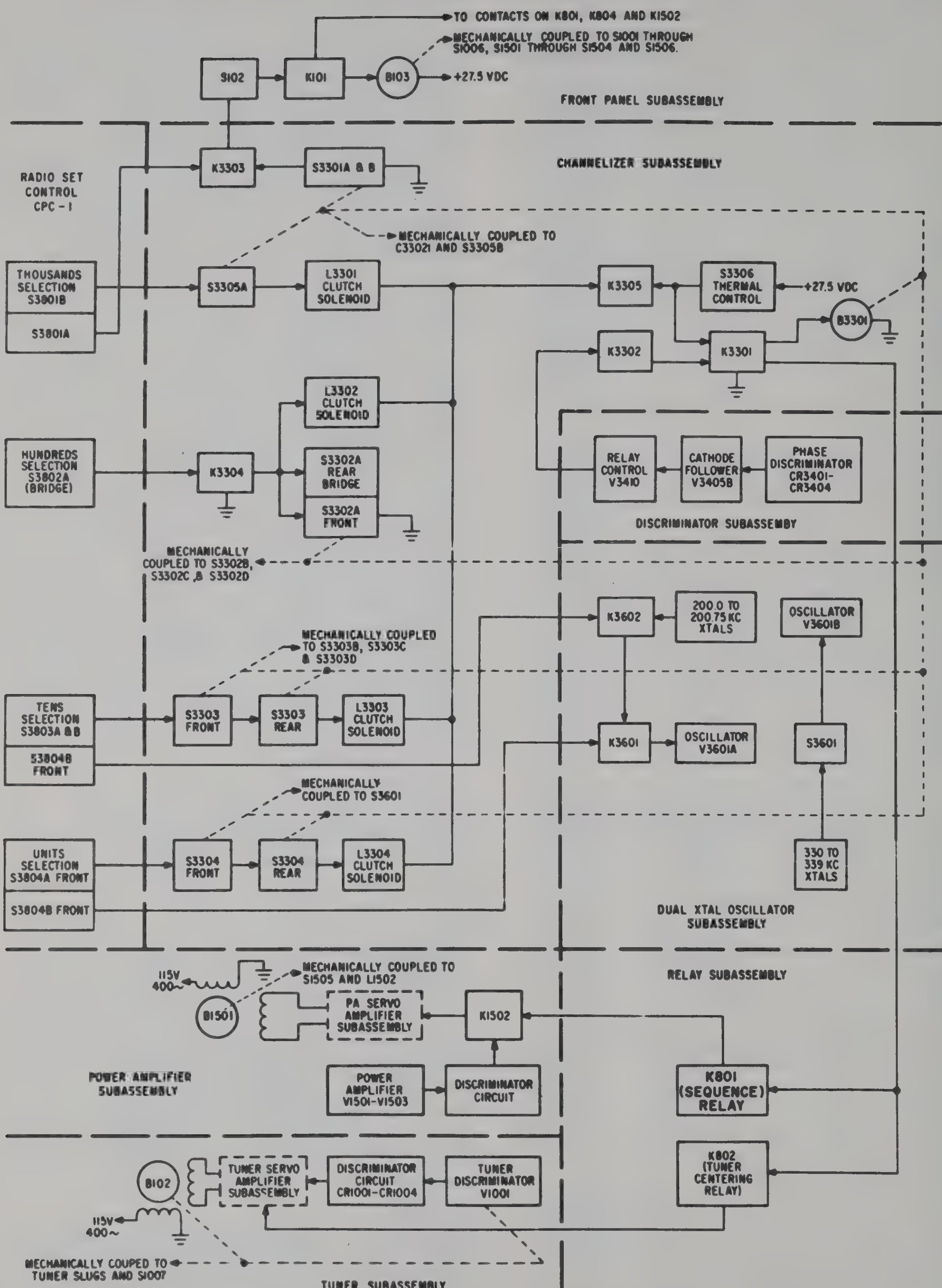


Figure 4-3. Control Circuits, Functional Block Diagram

crystals, Y3601 through Y3604. When the relay is deenergized, the 200.50 KC (Y3603) and 200.75 KC (Y3604) crystals are connected through the arms of K3602 to the poles of K3601. When K3602 is energized the 200.00 kc (Y3601) and 200.25 kc (Y3602) crystals are connected through the arms of K3602 to the poles of K3601. The latter relay is energized by means of the switch section S3804B located in the radio set control. Depending upon the operation of K3602, the relay K3601 when deenergized will connect either the 200.75 kc or 200.25 kc crystal to the grid circuit of V3601A. When energized, K3601 will connect either the 200.50 kc or 200.00 kc crystal to the grid circuit of V3601A. Selection of either crystal is dependent upon the operation of K3602.

4-28. Band changing is dependent upon the setting of the thousands switch in the radio set control as shown in figure 4-4. Switch section S3801A opens or closes a ground circuit to the coil of relay K3303. The four poles on this relay are connected to the band-change switch S102 located in the front panel subassembly. The two arms of K3303 are connected to the switch sections S3301A and S3301B which complete the ground circuit to the contacts of S102 and through the latter to the coil of K101. This relay serves three functions. When energized, the pawl on the ratchet mechanism is released, and one set of contacts of the relay completes the d-c circuit to the motor (B103). Operation of the motor rotates the shafts of the band selector switches in the tuner and power amplifier subassemblies until the selected band position is reached. When this occurs, the switch S102 opens the circuit to the relay coil. This action removes the ground circuit from the motor and causes the pawl to drop back into the notch of the ratchet, locking all rotating mechanisms at the selected band position. A second set of contacts on K101 connects the ground circuit to contacts on the sequence relay (K801), and the power amplifier centering relay (K1502).

4-29. The thermal switch, S3306 is provided to protect the motor, B3301. If any repeated channeling (in excess of one-minute) is attempted, the thermal element within S3306 will reach sufficient temperature to cause the enclosed switch to open the 27.5 volt d-c circuit to the relays K3301, K3305, the solenoids, and the motor. When this happens, it is necessary to turn equipment off at the radio set control and allow at least one-minute to elapse before reapplying power and re-channeling the equipment.

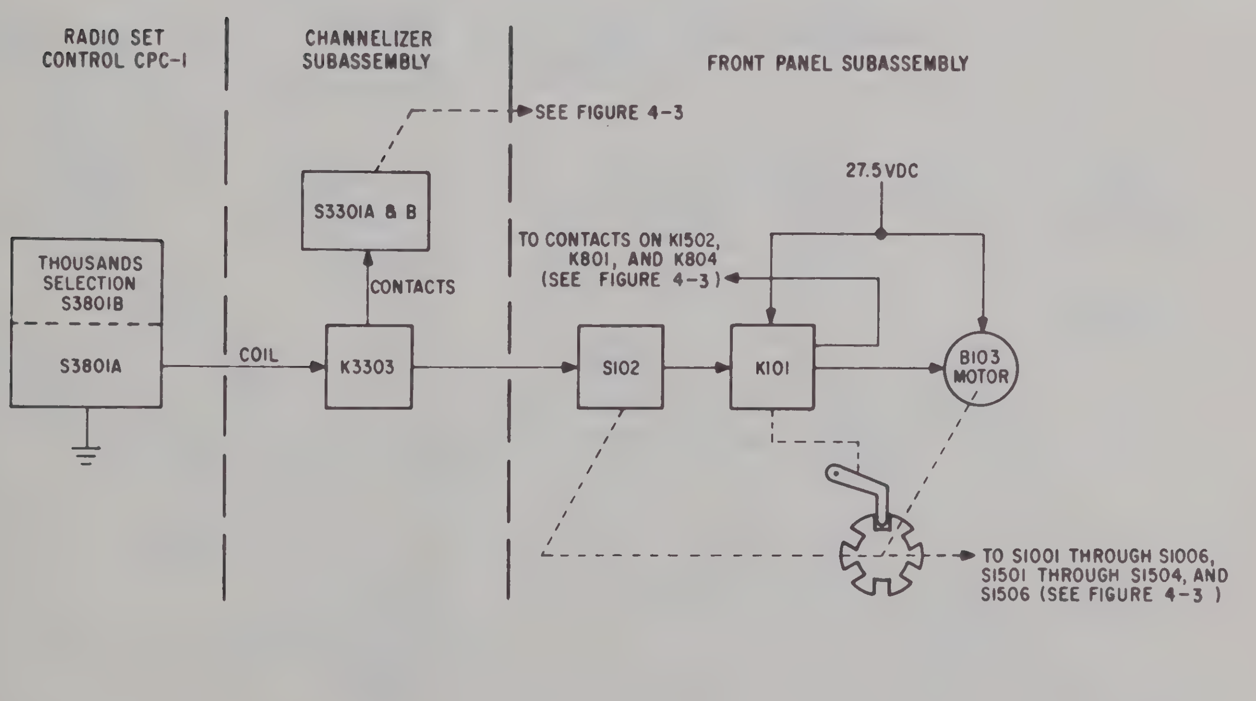


Figure 4-4. Band Change Circuit, Functional Block Diagram

4-30. Tuning of the slugs in the tuner amplifier subassembly is accomplished by means of the control circuit shown in figure 4-5. The output of the cmo is connected to the control grid of the tuner discriminator V1001. The tuner discriminator in conjunction with the tuner servo amplifier subassembly, and servomotor B102, performs the function of setting the tuner slugs to the correct operating position. With certain tuner slug positions, it might be possible to resonate the tuned circuits to the second harmonic of the master oscillator frequency. To prevent this from happening, the tuner table centering circuit is used to assure the return of the tuner slugs to the center position before setting up a new frequency. When the switch wafer contacts on S1007 are in an open circuit condition, the tuner slugs will be in the center position. When the tuned circuits are resonant at the selected frequency, the switch wafer contacts will be closed; however an open circuit for the 27.5-volt line will still exist until relay K3301 is energized. This relay is energized whenever a new channel is selected at the radio set control. Assume that the tuner slug rack is at rest and a new channel has been selected. A closed circuit now exists from ground through contacts of K3301, S1007 rear, through the coil of relay K802, and through contacts of S1007 front to the 27.5-volt line. Relay K802 is energized. Contacts on K802 connect to contacts on chopper G601 within the tuner servo amplifier subassembly. With S1007 front and rear rotated one position, one of the G601 contacts is connected between the voltage divider arrangement of R804 and R803, resulting in a d-c voltage being applied between the G601 contact and ground. The second G601 contact is connected across the parallel arrangement of R806 and R805 to ground and no voltage is present on this contact. The tuner servo motor B102 positions the tuner slug rack and rotates the switch sections of S1007. Switch S1007 will rotate until the contacts are at an open circuit position, at which time the tuner slugs will be centered and relay K802 is deenergized. If before the channel is changed, the tuner slug rack is at rest in such a position that the opposite direction of rotation of servomotor B102 is required to center the slugs, switch S1007 will be rotated in the opposite direction. In this case, as soon as relay K3301 is energized a ground circuit exists through the contacts of K3301, S1007 front, the coil of K802, and S1007 rear to the 27.5-volt line. Relay K802 is energized, but this time the voltage divider resistors selected are now R805 and R806. As a result,

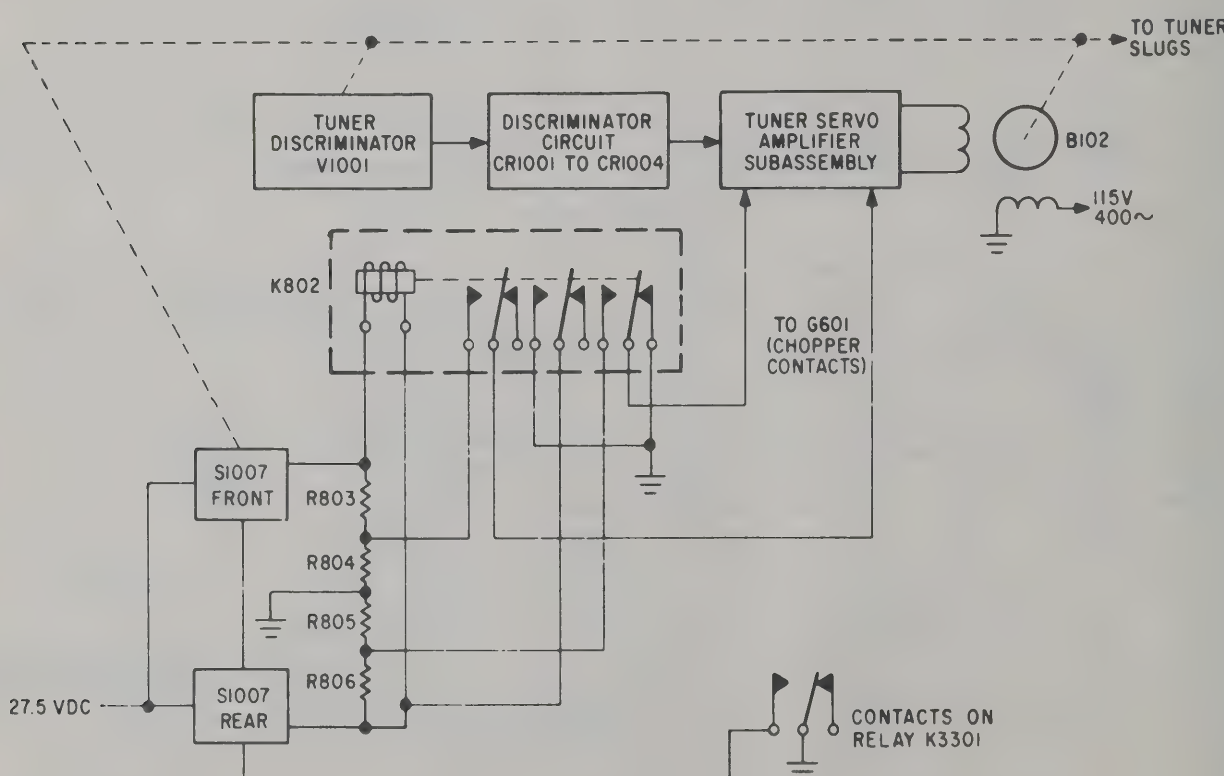


Figure 4-5. Tuner Centering Circuit, Functional Block Diagram

the voltage is applied to the opposite G601 contact, and the rotation of servomotor B102 will be in the opposite direction. After the tuner centering circuits have completed their cycle of operation, the tuner discriminator is free to drive the tuner slugs to the desired frequency, if the cmo has tuned. (If the cmo is still tuning, the tuner slug rack will be driven away from center until S1007 is no longer "open". With K3301 still energized, the centering sequence will be repeated until the cmo is tuned. This appears as a slug rack oscillation around the center position of the tuner. After the cmo is tuned, the tuner discriminator is free to drive the tuner slugs to the desired frequency.)

4–31. After the tuner centering circuits have completed their cycle of operation, the tuner discriminator is free to drive the tuner slugs to the selected frequency. One set of open contacts on relay K802 replaces the ground reference to chopper G601, allowing G601 to be controlled by the d-c output of the tuner discriminator. During the centering cycle, the tuner discriminator circuit output is overridden by the centering voltage and cannot drive the tuner servo amplifier circuits until the centering cycle is complete. A Foster-Seely type discriminator circuit, consisting of the diodes CR1001 through CR1004 and the associated resistors and capacitors, is used to produce a d-c output voltage. This voltage is amplified within the tuner amplifier servo amplifier subassembly and used to drive servomotor B102, which in turn drives all of the slugs in the tuner subassembly to resonance. When resonance is obtained the output of the discriminator circuit will be zero and B102 will cease to rotate.

4–32. Reference must be made to figure 4–6 in order to understand the functional operation of the band centering circuits of the power ampifier subassembly. Rough tuning of the power amplifier circuits consists of selecting the proper network values of inductance and capacitance for the band selected. Switches S1501 through S1504 perform these functions. Switches S1501, S1502, S1503 (capacitance), S1504 (inductance), and S1506 (centering) are rotated to the selected band position by the band selector autopositioner motor, B103, as described in paragraph 4–28. Switches S1506 and S1505 and the associated circuits perform the function of placing the roller of main tuning inductor L1502 to the center position of the band selected. The rear section of S1505 serves as a protective stop mechanism. If, for any reason, B1501 continues to rotate until the shorting roller of L1502 approaches either extreme end of travel, one of two sets of contacts on S1505 rear are shorted and the power amplifier band centering cycle recycles. With the centering circuits at rest and all switches set to the previously selected band it is desired to channel a frequency in a new band. The desired frequency is selected at the radio set control and the relay K3301 is energized. The ground circuit from the closed contacts of this relay is connected to the coil of the sequence relay K801 the closed contacts of which energizes relay K1502, and

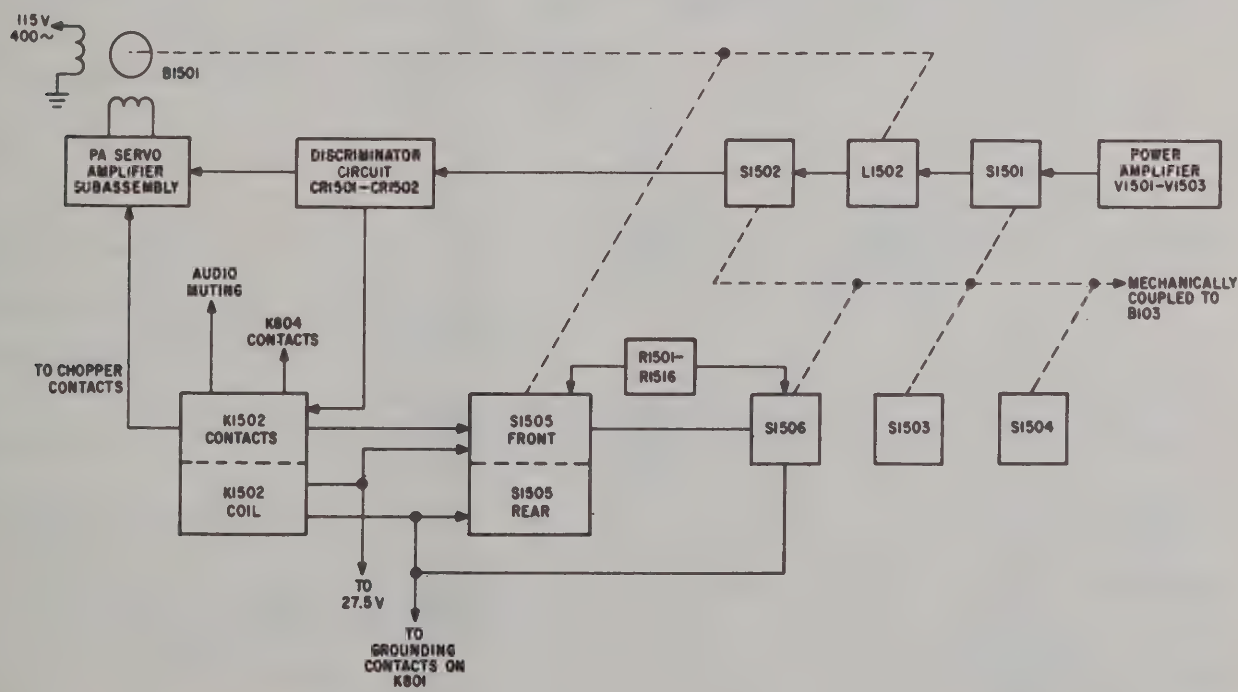


Figure 4–6. PA Centering Circuit, Functional Block Diagram

connects the ground circuit to contacts on S1506 and S1505 rear. Switch S1506 is rotated to the selected band position by operation of the band change autopositioner and motor B103. When relay K1502 operates, one set of contacts holds the relay operated. This is required as the ground supplied by K801 is removed when the correct frequency is selected in the channelizer subassembly. One side of the chopper coil (located in the power amplifier servo amplifier subassembly) G601 is grounded by contacts on K1502. As a result, an unbalanced voltage is fed to contacts of the chopper through the resistance network taps selected by the front section of S1505. This action drives the power amplifier servo mechanism and the servomotor B1501 rotates. Rotation of B1501 drives S1505 front and rear to the selected band center position, and the roller of L1502 is properly centered. After all these conditions are satisfied, the setting of the front section of S1505 will short the coil of K1502, causing its relay contacts to open and permit the phase discriminator to fine tune the power amplifier circuits.

4–33. The phase discriminator circuits used in the power amplifier subassembly are similar to the circuits employed in the tuner subassembly. During the centering cycle, the output circuits of the discriminator are opened by contacts on K1502. Upon completion of the centering cycle, the d-c output of the discriminator is applied to contacts on the chopper within the power amplifier servo subassembly through contacts on K1502. The servo amplifier subassembly used with the power amplifier is identical to the one used for the tuner subassembly. In this application, servo motor B1501 is driven by the servo amplifier, and the roller on the inductor, L1502 is properly positioned instead of tuning slugs.

4–34. POWER SUPPLY 416W–1.

4–35. GENERAL. Power Supply 416W–1 provides and controls the operating voltages to all of the equipment in the system. Power sources of 115 volts, 400 cps, 115 volts, 320 to 1000 cps, and 27.5 volts dc are required for operation. The 115-volt a-c sources are required to furnish operating power to a voltage-doubler rectifier supply, a bias voltage rectifier supply, and all of the a-c voltages required for operation of the receiver-transmitter and antenna tuner. The 27.5–volt d-c source is used to supply operating voltage to the dynamotor, control circuits of the power supply, receiver-transmitter, and antenna tuner, and all filament voltages.

4–36. FUNCTIONAL OPERATION. The 27.5–volt d-c source is connected to the power supply circuits by means of two thermal circuit breaker switches, S1601 and S1602 as shown in figure 4–7. The voltage

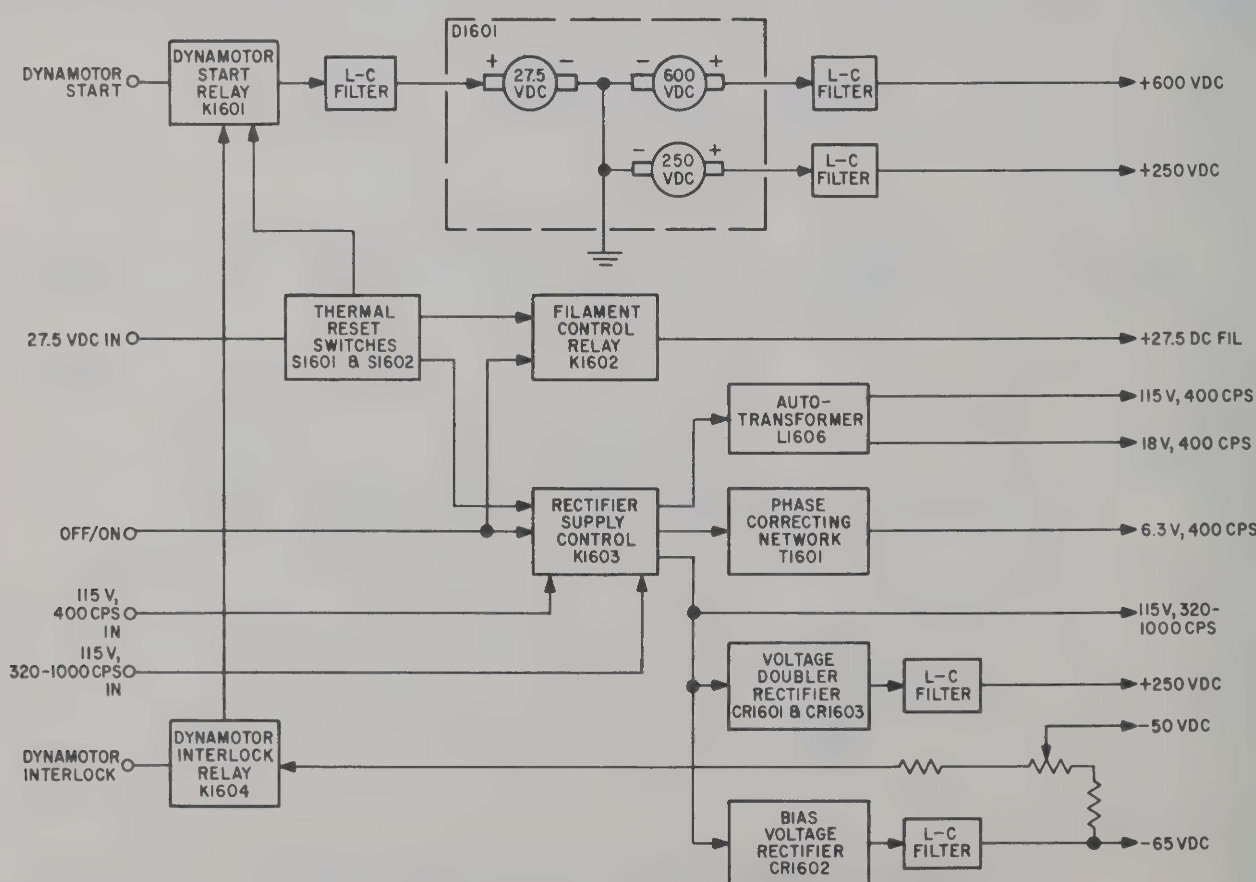


Figure 4–7. Power Supply, Functional Block Diagram

is then connected to the coils of a filament control relay (K1602) and a rectifier supply control relay (K1603). When the operating mode switch on Radio Set Control CPC–1 is operated to any "ON" position, the coils of K1602 and K1603 are connected to ground. The resultant closed contacts on K1602 connects the 27.5-volt d-c source to all of the filaments and control circuits in the equipment. Simultaneously, one set of contacts on K1603 connects the 115-volt, 400 cps source to the output of the auto-transformer circuit (L1606), and the phase correcting network associated with T1601. The auto-transformer circuit supplies 18 volts, 400 cps (not used in this application) and the phase correcting network supplies 6.3 volts, 400 cps in the correct phase relationship to the receiver-transmitter. A second set of contacts on K1603 connects the 115-volt, 320 to 1000-cps source to the two rectifier supplies. The voltage-doubler rectifier supply provides +250 volts dc to the equipment. The —65 bias voltage is not used in this application, however, the current through a voltage divider, connected across the output of the bias voltage rectifier supply flows through the dynamotor interlock relay, K1604. The contacts on this relay must be closed before the dynamotor start relay (K1601) will operate. Therefore, relays K1602, K1603, and K1604 must all operate before it is possible to energize dynamotor, D1601. The contacts of K1604 are connected in series with the coil of K1601 and a set of contacts on the sequence relay K801 opens the circuit during channeling time so the dynamotor can not be operated while changing frequencies. After relays K1602, K1603, and K1604 have been energized, and K801 has been de-energized, 27.5 volts dc is available at the coil of K1601. The other side of the coil obtains ground through the mode switch in the radio set control, or through the microphone push-to-talk button depending upon the mode of operation. When the mode switch is set to the "AME" or "SSB" position, ground is provided by the microphone push-to-talk switch. Closing of the switch contacts energizes K1601 and the closed contacts of the relay applies 27.5 volts dc to the dynamotor. When the mode switch is set to the "CW" position, ground is supplied continuously to K1601. With the dynamotor energized, +250 volts and +600 volts dc are available for operation of the transmitting circuits in the receiver-transmitter and the tubes in the antenna tuner.

SECTION V

DESCRIPTION OF SYSTEM TIE-IN OF EQUIPMENT AND ACCESSORIES

5-1. RADIO SET 618S-1/MC.

5-2. INDEX TO DIAGRAMS. Figure 5-1 is the only diagram included in this section.

5-3. SYSTEM DIAGRAM. A block diagram showing Radio Set 618S-1/MC connected into a complete communications system is illustrated in figure 5-1. The receiver-transmitter contains various subassemblies interconnected on a single chassis to comprise a receiver, a transmitter, and the necessary control circuits for automatic tuning.

5-4. The receiver section consists of a highly selective, sensitive, high-frequency receiver for equivalent amplitude modulation, continuous wave, single sideband, and frequency shift keying reception. The transmitter is a long-range, stable, automatically-tuned transmitter for ame voice, ssb voice, cw, and frequency shift keying transmissions.

5-5. An automatically-resonated master oscillator produces and controls the basic frequencies which after being multiplied, provide 35,250 transmission and reception channels. Tuning is entirely automatic. No facilities are provided for external manual tuning. Radio Set Control CPC-1 is used to select the frequency of operation and the operating mode. In addition the audio level from the receiver can be adjusted from the front panel of the radio set control. Frequency control is achieved through a switching and motor drive system. The same tuning system controls the resonating circuits of the antenna tuner which automatically matches the output of the receiver-transmitter to the impedance of the antenna at the selected operating frequency.

5-6. Audio input and output information and CW keying of the transmitter can be made by connecting the microphone, key, and headset through the aircraft intercom system, or by connection through the panel mounted Jacks on the receiver-transmitter.

5-7. Teletype operation is provided by feeding the output of a teletypewriter into a frequency shift keying adapter (not supplied). The teletypewriter information is then transmitted. In reception, the received information is converted by means of the adapter into positive and negative d-c pulses for operation of the teletype loop.

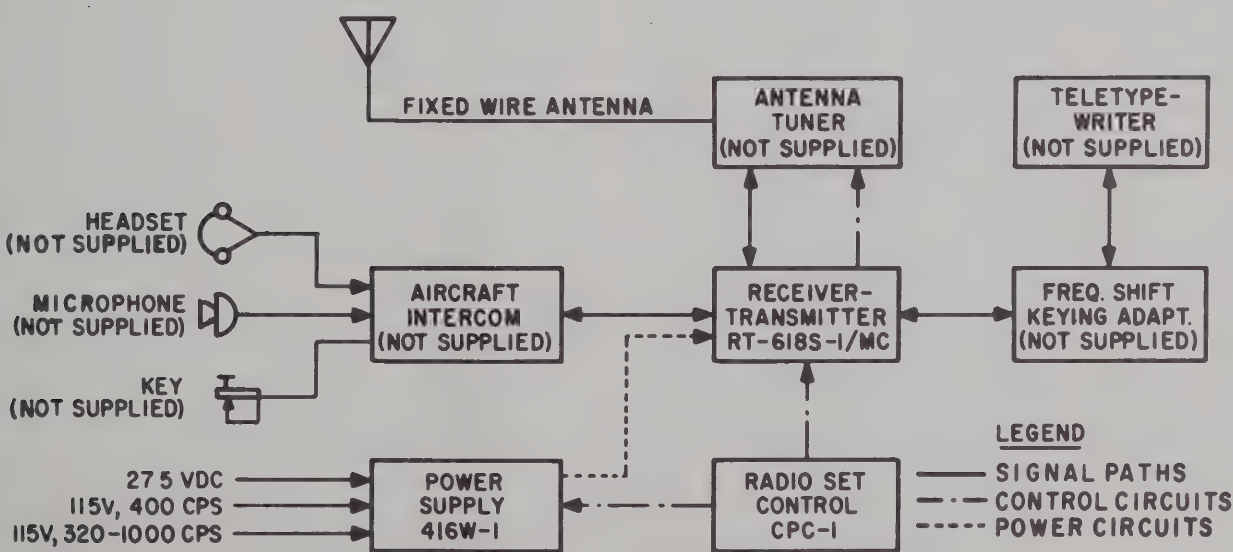


Figure 5-1. System Block Diagram

SECTION VI
CHECK-OUT OR ANALYSIS

6–1. INTRODUCTION.

6–2. GENERAL. This section describes the procedures to be performed in order to locate a malfunctioning component or circuit in Radio Set 618S–1/MC. An efficient job of locating trouble in the radio set depends upon the ingenuity of the maintenance technician and his familiarity with the circuits involved. Therefore, it is imperative for the technician to study the theory of operation (Section IV) and the portions of the sections containing individual component circuit analysis. In general, a quick check for open tube heaters and plate voltage to the various subassemblies of the malfunctioning component will provide a starting point for trouble analysis. If failure is only partial, or if an operating equipment fails to meet the minimum performance standards outlined in paragraph 6–9, the trouble may be localized by noting at which points the grid-driving voltages deviate from normal values. Vacuum tubes should be checked as a reasonable possibility if receiver sensitivity is low or transmitter power output is below normal.

6–3. VACUUM TUBES. All tubes in the radio set are connected in series-parallel across the 27.5-volt dc supply in such a manner as to minimize the power dissipated in the dropping resistors. For this reason all tubes and subassemblies should be connected in place before power is applied. The equipment should always be in the key-up position before power is applied in order to allow the power amplifier tubes to warm up before full plate voltage is applied. A minimum of two-minutes warmup time is recommended before keying the transmitter. To avoid damage to the tubes the d-c supply voltage should not exceed the normal 27.5-volts dc by more than five to ten percent. Excessive voltage for long periods of time will cause shortened tube life. Rated plate currents and plate dissipation should not be exceeded for the same reason.

6–4. TUBE REPLACEMENTS. Before any tube in the radio set is removed for replacement or checking, make certain all power has been removed from the equipment. This can be accomplished by operating the function switch on the radio set control to the "OFF" position. Check all replacement tubes carefully to be sure they are the correct type and contain no defects. If a tube failure is due to an open heater, it will cause an unbalance in the filament circuit because the tubes are connected in series parallel. Measuring the voltage across the different sections of the heater circuits will sometimes help to locate which tube has failed. Reference is made to figure 6–1 for filament measurement points and voltages. The quickest method of finding a tube with an open heater is to disconnect the equipment from the 27.5–volt dc supply and connect a six-volt battery across the suspected tube. Under this condition, the tube will glow normally unless defective. For this test it will be obvious that the six-volt battery must be free of ground, except when checking a filament that is grounded. Battery connections can be made temporarily by means of clip leads. When an open heater is found, all tubes within the same series-parallel string as the defective one should be removed and checked on tub Tester TV–3B/U to determine if they are damaged due to excessive heater current. Examination of figure 6–1 will show the tubes in the individual series-parallel strings.

6–5. SEMICONDUCTORS. Various types of rectifier diodes are used throughout this equipment. These diodes are used in some circuits as control elements and in others as straight a-c to d-c converters (rectifiers). When a diode is suspected of being defective, it can be checked with an ohmmeter. This can be accomplished by first noting the resistance measured with the probes of the ohmmeter connected across the diode and then reversing the probe connections and again noting the resistance measurement. The ohmmeter range should be selected that gives a positive indication for each connection of the probes. A good diode will have a forward-to-back resistance measurement of at least 10-to-1 with the diode disconnected from the circuit. When making an in-circuit measurement, circuit elements may or may not affect this ratio. Therefore, it is necessary to consider all shunt and series resistances in the circuit being checked before attempting a replacement. In almost all in-circuit tests, a normally operating diode will have a higher back resistance than its forward resistance even though the 10-to-1 ratio is not obtained. If a low or zero resistance in both directions is indicated by the ohmmeter, the diode is shorted. If a high resistance is indicated in both directions, the diode is open.

6–6. BENCH TEST SETUP.

6–7. GENERAL. The equipment under test must be placed in a bench test setup in accordance with the procedures outlined in paragraph 2–7 and as shown in figures 2–1 and 2–2. Fabrication of intercomponent cables is to be accomplished as described in paragraph 3–7 and interconnections made as shown in figure 3–5.

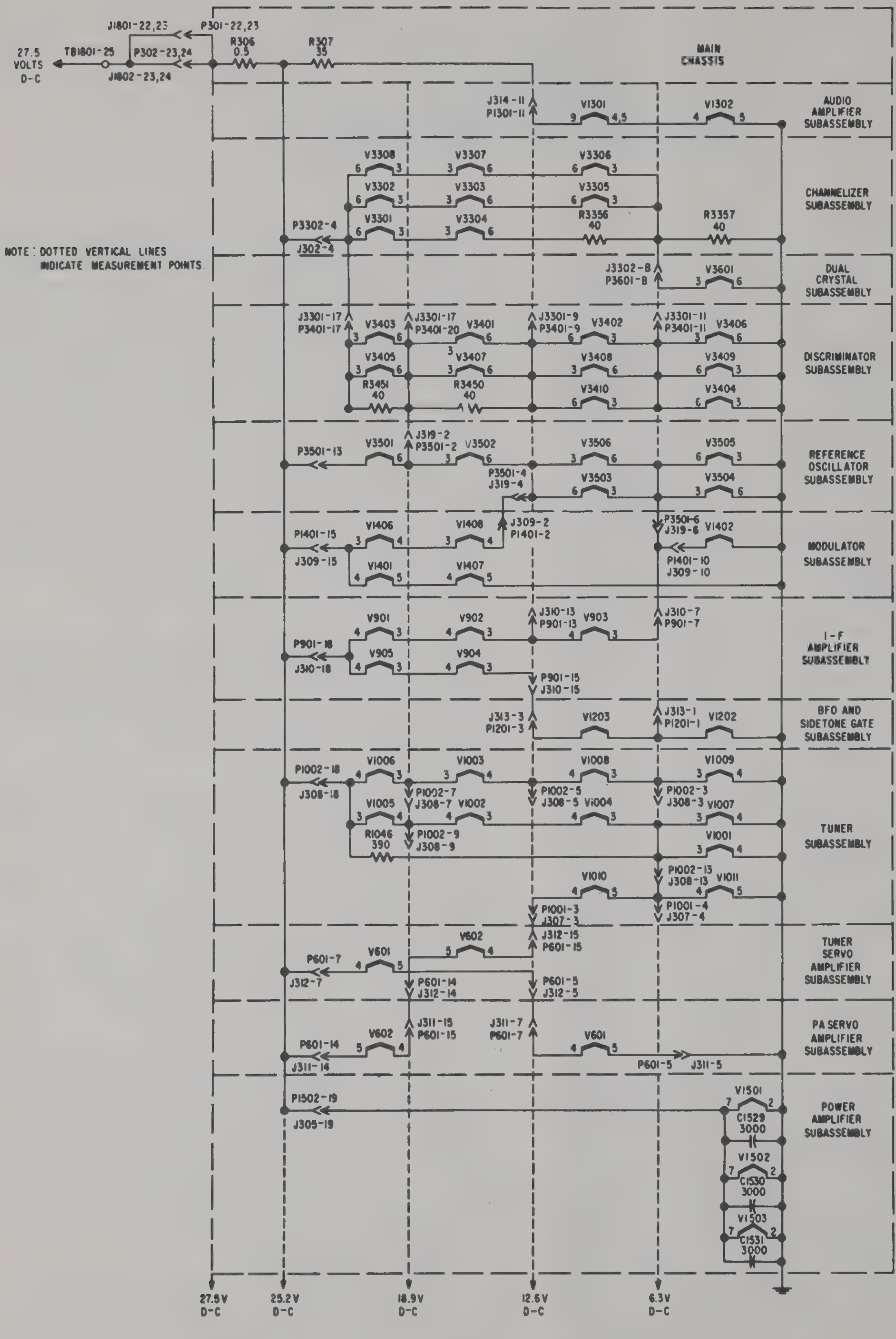


Figure 6–1. Filament Voltage Distribution

Subassembly interconnecting cables are to be fabricated as explained in paragraph 3-9 and as shown in figures 3-7 through 3-11. Test equipment connections and test point references are to be made in accordance with those shown in figures 2-2, 7-2, and 7-3, and the individual subassembly illustrations.

6-8. If only one component in the system has been received for checkout, the particular component must be connected in a bench test setup of system components known to be performing normally. When performing the tests in this section, the volume control on the front panel of Radio Set Control CPC-1 must be set to its maximum clockwise position unless otherwise indicated.

6-9. MINIMUM PERFORMANCE STANDARDS.

6-10. GENERAL. The test procedures outlined in paragraphs 2-7 through 2-18 provide minimum standards of performance for Radio Set 618S-1/MC. These tests can be used to analyze suspected trouble, or to test the equipment after a repair, adjustment, or realinement procedure has been performed. The detailed performance tests that follow are to be used to supplement the tests described in paragraphs 2-7 through 2-18. All test points indicated in the following procedures are shown in figure 2-2.

6-11. AVC CHARACTERISTICS.

a. Connect Output Meter TS-585B/U to J101 (test point 4). Set to the 500-milliwatt range with the internal impedance at 300 ohms.

b. Connect Signal Generator AN/URM-25 to J109 (test point 3) and tune to 2.75 megacycles as monitored on Frequency Meter AN/USM-26.

c. Adjust the AN/URM-25 output level to 10 microvolts modulated 30 percent at 1000 cps.

d. Operate the function switch on Radio Set Control CPC-1 to the "AME" position and allow the equipment to warm up for a minimum of 10 minutes.

e. Set the channel selectors on the radio set control to 2.75 megacycles (DDBB). Note the output meter reading and increase the output level of the signal generator to 100,000 microvolts. Observe the change in output power. The power output should not be greater than 2.24 times the reading for 10 microvolts input which corresponds to a 3.5-db change.

f. Set the signal generator output to 1000 microvolts and note the output meter reading. Increase the signal generator output to 1 volt. The indication on the output meter should not increase more than 4 to 1, which corresponds to a 6-db change.

g. Perform the avc tests outlined in steps e and f for the following frequencies: 5.25, 10.25, and 20.25 megacycles.

6-12. RECEIVER SELECTIVITY.

a. Perform steps a, b, and c of paragraph 6-11.

b. Connect VTVM TS-375/U to terminal 5 of chassis receptacle J310 (test point 7). Set the vtvm to read on the negative 3-volt scale.

c. Perform steps d and e of paragraph 6-11.

d. Adjust the signal generator output level for a reading of exactly negative 1-volt d-c on the vtvm.

e. Double the signal generator output level and detune the signal generator above and below the 2.75-megacycle setting. Observe the signal generator frequencies on the Frequency Meter AN/USM-26 where the reading on the vtvm returns to negative 1-volt d-c. The difference between the two frequencies is an indication of the receiver bandwidth at the 6-db-point and should not be greater than 14 kilocycles.

f. Repeat steps d and e with the channel selectors on the radio set control set to the following frequencies: 5.25, 10.25, and 20.25 megacycles. The signal generator must be adjusted to the respective operating frequencies by means of the frequency meter.

6-13. RECEIVER FREQUENCY RESPONSE.

a. Perform steps a, b, c, d, and e of paragraph 6-11 with the following exception: set the channel selectors on the radio set control to 2.0 megacycles (BKBB).

b. Record the reading of the output meter.

c. Change the modulation frequency to 300 cps and note the change in reading on the output meter. The change in reading should not be greater than 2.24 times (3.5 db) the reading recorded in step b.

d. Change the modulation frequency to 3000 cps and observe the indication on the output meter. The change in reading should not be greater than 10 times (10 db) the reading recorded in step b.

e. Repeat the frequency response tests outlined in steps b through d for at least one frequency in each of the three remaining bands.

6-14. SIDETONE POWER.

a. Perform step a of paragraph 6-11.

b. Connect the dummy microphone to J102 (test point 5).

c. Connect Audio Oscillator TS-382A/U to the dummy microphone circuit input and tune the oscillator to 1000 cps.

d. Connect the dummy load and oscilloscope to E102 or J110 (test point 1).

e. Operate the function switch on the radio set control to the "AME" position and allow at least 10 minutes for warm up.

f. Operate the channel selectors to 2.0 megacycles (BKBB).

g. Insert a telegraph key into J103 (test point 6) and depress.

CAUTION

The maximum duty cycle of this equipment is five minutes carrier-on. Therefore, never key the transmitter for a longer period. If keyed for the maximum of five minutes, allow at least a five-minute period to elapse in the carrier-off (key up) condition to permit the heat to be dissipated, and the equipment to return to normal operating temperature.

h. Adjust the output level of the audio oscillator for 100-percent modulation of the r-f carrier as observed on the oscilloscope.

i. Adjust the front panel mounted "PHONE SIDETONE" control (R106) for a power output of 300 milliwatts as observed on the output meter.

j. Release the telegraph key and disconnect the audio oscillator.

k. Operate the function switch on the radio set control to the "CW" position.

l. Depress the telegraph key and adjust the front panel mounted "CW SIDETONE" control (R107) for a power output of 300 milliwatts as observed on the output meter. Observe the previous precaution while making this adjustment.

6–15. AME MODULATION FIDELITY.

a. Perform steps a, b, c, d, e, f, and g of paragraph 6–14.

b. Adjust the output level of the audio oscillator for 60-percent modulation of the carrier as observed on the oscilloscope.

c. Keeping the output level of the audio oscillator to that determined in step b, vary the frequency between the limits of 300 and 3500 cps. The percentage of modulation should remain within the limits of 40 to 70 percent.

d. Change the output frequency of the audio oscillator to 5000 cps. The percentage of modulation should not be less than 22 percent.

e. Change the output frequency of the audio oscillator to 6500 cps. The percentage of modulation should not be more than 12 percent.

f. Perform the modulation fidelity tests outlined in steps b through e for at least one frequency in each band of operation.

6–16. SYSTEM TROUBLE ANALYSIS.

6–17. GENERAL. In troubleshooting procedures, localization of the trouble to a specific component or subassembly of the equipment must be performed before proceeding to the component maintenance sections. The radio set under test must be connected in the bench test setup shown in figure 2–1. Automatic Antenna Tuner 180L–3 (shown in figure 2–1) can be used for the troubleshooting procedures if desired. However, the antenna tuner must be in proper operating condition. Where trouble develops in the operation of the antenna tuner, the applicable service manual must be referenced in order to clear the fault. Where the antenna tuner is not used in the bench test setup, a jumper wire or spst switch must be connected in series with terminal 13 of TB1801 and ground. With this terminal grounded, the transmitter can only be operated in the tune mode.

6–18. TROUBLE ANALYSIS CHART. Figure 6–2 lists some of the malfunctions that may be encountered in the use of this equipment. This chart will aid the technician in isolating the defective component, subassembly, or circuit in the radio set. Further checks of the indicated subassemblies or circuits causing the malfunction are then performed by means of the trouble analysis procedures for the receiver-transmitter outlined in Section VII and Section IX for the power supply. In order to keep the down time of the aircraft at a minimum, it is recommended that a defective subassembly be replaced by one known to be functioning normally, and the replaced unit checked and repaired when more convenient.

Symptom	Probable Cause	Remedy
1. System inoperative	1a. Open or shorted connections to power sources	1a. Check cables between 115V, 400 cps and 27.5-vdc power sources and power supply.
	1b. Malfunction in Power Supply 416W–1	1b. Replace power supply. If this clears the trouble, check defective unit as outlined in Section IX.
	1c. Damaged contacts on function switch of Radio Set Control CPC–1	1c. Replace radio set control. If this clears the fault, check contact closure on S3805 and if defective, replace.
	1d. Poorly seated plugs or defective interconnecting cables	1d. Check all interconnecting cable plugs to make certain they are properly seated in their mating receptacles and check for open or short-circuited wires in cables.
2. Tuning malfunction	2a. Radio Set Control CPC–1	2a. Replace radio set control.
	2b. Antenna tuner interlock	2b. Check operation of antenna tuner interlock circuit as described in applicable service manual.
	2c. Channelizer subassembly circuits	2c. Replace subassembly.
	2d. Tuner discriminator circuit malfunction	2d. Check V1001 for quality.
	2e. Discriminator Subassembly	2e. Replace subassembly. If this clears fault, check as outlined in paragraph 7–90.

Figure 6–2. System Trouble Analysis (Sheet 1 of 3)

Symptom	Probable Cause	Remedy
2. Tuning malfunction (cont)	2f. Reference Oscillator Subassembly	2f. Replace subassembly.
	2g. Dual Crystal Oscillator Subassembly	2g. Replace subassembly. If this clears fault, check as outlined in paragraph 7-81.
	2h. Tuner and Power Amplifier Servo Amplifier Subassemblies	2h. Replace respective subassembly. Check as outlined in paragraphs 7-150 and 7-174, respectively.
	2i. Relay Subassembly	2i. Replace subassembly. Check as outlined in paragraph 7-199.
	2j. Main Chassis Relays	2j. Check operation of all relays on main chassis. Make certain all contacts close properly. Replace as required. See figure 7-122.
	2k. Servo Motor, B102	2k. Check B102 operation. Also make certain J106 is properly mated with P106. Replace as outlined in paragraph 7-217.
	2l. Autopositioner Motor, B103	2l. Check B103 operation. Make certain P107 is properly mated with J107. Check operation and contact closure of S102 and K101. Refer to paragraph 7-219.
	2m. Antenna tuner	2m. Check in accordance with instructions in applicable service manual.
	2n. Power Amplifier Tuning Motor, B1501	2n. Check motor and relay (K1502) operation. Refer to paragraph 7-160.
3. Transmitter inoperative (no r-f output sidestone heard in headset)	3a. Antenna tuner malfunction	3a. Same as 2m.
	3b. Power Amplifier Subassembly	3b. Replace subassembly. Check as outlined in paragraph 7-160.
4. Transmitter inoperative (no r-f output and no sidetone heard in headset)	4a. Tuner Subassembly	4a. Replace subassembly. Check as outlined in paragraph 7-115.
	4b. Channelizer Subassembly	4b. Check cmo and buffer tubes and associated circuits, as outlined in paragraph 7-37.
	4c. BFO and Sidetone Gate Subassembly	4c. Replace subassembly. Check as outlined in paragraphs 7-239.
	4d. Audio Amplifier Subassembly	4d. Replace subassembly. Check as outlined in paragraph 7-247.
5. No sidetone in headset (ssb and ame modes)	5a. BFO and Sidetone Gate and Audio Amplifier Subassemblies	5a. Replace subassemblies. Check as outlined in paragraphs 7-239 and 7-247, respectively.
	5b. Headset	5b. Replace headset.
	5c. Audio circuits in Modulator Subassembly	5c. Replace subassembly. Check as outlined in paragraph 7-180.
	5d. Microphone	5d. Replace microphone.
6. No sidetone in headset (cw mode)	6a. Sidetone circuit	6a. Same as step 5.
	6b. Same as step 5	6b. Same as step 5.
7. Varying output signal when transmitting	7a. Automatic Level Control Circuit	7a. Replace Reference Oscillator and Modulator Subassemblies. Check as outlined in paragraphs 7-105 and 7-180, respectively.
	7b. Interconnecting chassis wiring	7b. Check all interconnections for short or open circuits. See figures 7-120, 7-121, and 7-124.
8. No, or weak modulation	8a. Modulator and Reference Oscillator Subassemblies	8a. Replace subassemblies. Check as outlined in paragraphs 7-180 and 7-105, respectively.
	8b. Defective microphone	8b. Replace microphone and check microphone input jack and associated circuits.

Figure 6-2. System Trouble Analysis (Sheet 2 of 3)

Symptom	Probable Cause	Remedy
9. Receiver inoperative (ame and cw modes)	9a. Receiver circuits of Tuner Subassembly	9a. Replace subassembly. Check as outlined in paragraph 7-115.
	9b. I-F Amplifier Subassembly	9b. Replace subassembly. Check as outlined in paragraph 7-223.
	9c. Audio Amplifier Subassembly	9c. Replace subassembly. Check as outlined in paragraph 7-247.
	9d. Relay Subassembly	9d. Replace subassembly. Check as outlined in paragraph 7-199.
	9e. Malfunction in main chassis relays	9e. Check relays for operation and positive contact closure. Replace as required. See figure 7-122.
10. Receiver inoperative (ssb mode)	10a. Single sideband demodulator tube (V3503) in Reference Oscillator Subassembly	10a. Check tube or replace subassembly. Check as outlined in paragraph 7-105.
	10d. Reference Oscillator Subassembly	10b. Replace subassembly. If this clears fault, check 250-kc oscillator and buffer circuits (V3502). Check as outlined in paragraph 7-105.
	10c. Same as steps 9c through 9e	10c. Same as steps 9c through 9e.
11. No sidetone when receiving cw	11a. BFO and Sidetone Gate Subassembly	11a. Replace subassembly. If this clears fault, check as outlined in paragraph 7-239.
	11b. Defect in Relay Subassembly and/or main chassis relays	11b. Replace subassembly. Check all relays for operation and positive contact closure as outlined in paragraph 7-199.

Figure 6-2. System Trouble Analysis (Sheet 3 of 3)

SECTION VII

MAINTENANCE INSTRUCTIONS FOR RADIO RECEIVER-TRANSMITTER 618S–1/MC

7–1. SCOPE OF SECTION.

7–2. GENERAL. This section contains instructions for trouble analysis, repair, and adjustment of the various subassemblies contained in a Receiver-Transmitter 618–1/MC which fails to meet minimum performance standards. The assemblies and subassemblies of the receiver-transmitter are listed in figure 7–1.

7–3. DIAGRAMS.

7–4. GENERAL. Because of the relative complexity of the receiver-transmitter and the number of assemblies and subassemblies involved, no one overall schematic diagram is presented. Instead, a schematic diagram for each subassembly and an overall interconnection diagram has been provided. Any referenced diagram can be located by referring to the list of illustrations in the Table of Contents, or by referring to the index to diagrams in this section.

Assembly or Subassembly	Symbol Series
Front Panel	100–199
Main Chassis	300–399
Tuner and Power Amplifier Servo Amplifiers	600–699
Relay	800–899
I-F Amplifier	900–999
R-F Tuner	1000–1099
	1100–1199
BFO and Sidetone Gate	1200–1299
Audio Amplifier	1300–1399
Modulator	1400–1499
R-F Amplifier	1500–1599
Channelizer	3300–3399
	33000–33099
Discriminator	3400–3499
Reference Oscillator	3500–3599
Dual Crystal Oscillator	3600–3699

Figure 7–1. Receiver-Transmitter Subassemblies

7–5. SCHEMATIC DIAGRAMS. Each schematic diagram shows all signal, power, and control circuits in the individual subassembly. Where one or more subassemblies are contained in an assembly, the grouping of parts is outlined in dash lines and symbolized by an A, T, or Z number. All parts within the dash lines belong to that subassembly.

7–6. Circuits which extend to or come from other subassemblies are labeled to indicate their terminations. Other circuits which terminate in a plug, terminal strip, jack, etc. are labeled at the particular terminal where the circuit enters or leaves the subassembly.

7–7. A system of test point indentification symbols has been incorporated on all schematic diagrams. A more detailed explanation of this system is given in paragraph 4–3. Figure 2–2 shows major test points, figures 7–2 and 7–3 show secondary test points, and the individual subassembly figures contain the respective minor test points where applicable.

7–8. SIMPLIFIED SCHEMATIC DIAGRAMS. Each simplified schematic diagram covers a signal, power, or control circuit contained in an individual unit. Each detail part on the simplified schematic diagram is assigned the same symbol number as appears on the subassembly schematic diagram. Signal circuits which extend to or come from another subassembly or component show the circuit symbol or designation of the first connection within the terminating or input subassembly.

7–9. INDEX TO ILLUSTRATIONS.

7–10. The following illustrations are included in this section.

7-11. MAINTENANCE PROCEDURES.

7-12. GENERAL. In order to locate trouble in the shortest possible time, a logical testing routine should be followed. First, isolate the trouble to one of the following sections of the equipment: one of the plug-in subassemblies, power supply, control system, antenna system, servo system, or other functional loop. Figure 6-2 will be of aid to the technician in the isolation of a section of malfunctioning equipment. Trouble should be known to exist in a particular subassembly before the procedures in this section are used to isolate the trouble to a detail part. Troubles in the control or tuning system generally manifest themselves in improper or no channel, or band selection. Troubles in the r-f or i-f sections of the equipment generally are concealed to the extent that a careful check must be made in order to locate the defect. Troubleshooting is simplified in the sense that a suspected subassembly can be removed and replaced by one known to be functioning normally. If the trouble disappears, the replaced subassembly contains a defective part.

CAUTION

Discretion must be exercised before replacing a suspected subassembly with a properly operating unit. In some instances, replacement of the suspected subassembly may result in a second defective unit. The nature of the trouble must be analyzed before a replacement is made. Examine the suspected subassembly for obvious faults, such as burned or scorched parts, etc., and check their circuit location on the respective schematics before replacing the unit. In removing and replacing any of the subassemblies, loosen and tighten only those screws with red heads. These screws are captive hold-down screws painted red to indicate their function.

7-13. A subassembly can be checked in the modified Test Set 478H-1 as outlined in the applicable operating manual. When checking defective units, the subassemblies must sometimes be removed from the main chassis and reconnected to the equipment circuits by means of the patch cables fabricated as described in paragraph 3-7. Tube voltages can be measured by removing a tube from its socket, inserting it into an adapter, and reinserting the tube and adapter into the socket.

7-14. Defects discovered during the tests should be corrected immediately. Alinement and tracking procedures should not be attempted unless it has been established definitely that the malfunction is due to misalinement. Always check other possibilities before attempting to perform alinement or tracking procedures as a remedy. When reference is made to meter indications on various pieces of test equipment, it should be remembered that the readings are nominal values measured on a normally operating equipment. It is possible that any given equipment will operate normally if the meter readings vary slightly from those stated. It is absolutely essential that all test equipment be calibrated and terminated properly, and in otherwise excellent condition.

7-15. BENCH TEST SETUP. The receiver-transmitter containing a malfunction is to be tested in the bench

test setup described in paragraph 2–6. Patch cables for connecting subassemblies under test to the main chassis circuits are to be fabricated in accordance with the instructions outlined in paragraph 3–7.

7–16. MINIMUM PERFORMANCE STANDARDS. After replacement of defective parts, the subassemblies must be checked in the receiver-transmitter in the system test as described in paragraph 6–9.

7–17. VOLTAGE DISTRIBUTION.

WARNING

Operation of Radio Set 618S–1/MC involves voltages that are fatal. When performing maintenance procedures, special care must be taken to avoid contact with detail parts carrying plate voltages. Also, clothing, rags, and test leads should be kept free from the moving mechanical parts during the channeling cycle.

7–18. PRIMARY VOLTAGE DISTRIBUTION. All voltages are supplied to the receiver-transmitter through the receptacles (P1601/J1601) of Power Supply 416W–1. Figure 7–4 illustrates the distribution of voltages to the various receptacles and relays of the component. Always measure voltages at the receptacle pins of a suspected subassembly when attempting to isolate a malfunction. If any measured voltage is abnormally low with the subassembly in place, but returns to normal when the subassembly is removed, it is a definite indication of a short circuit or other abnormal condition in the subassembly. If after removal of the subassembly, the low voltage persists, a defect exists in the interconnecting wiring, power supply, or some other subassembly connected to the common source. Careful study of figure 7–4 will show that certain voltages are supplied to some receptacles and relays through contacts of other relays. Therefore, it is possible for malfunctioning relay to cause low or no voltage readings at certain points. Always make certain that the relays in any malfunctioning circuit are operating normally before proceeding.

7–19. B-PLUS VOLTAGE DISTRIBUTION. Two 250-volt d-c and one 600-volt d-c supplies are employed as described previously. The 600-volt and one of the 250-volt supplies originate at the 27.5-volt d-c power source, which is stepped-up by dynamotor D1601, and applied to the various subassemblies as shown in figure 7–3. The second 250-volt supply originates at the 115–volt, 400 cps power source. This source is stepped-up, rectified, and filtered through circuits within Power Supply 416W–1 and applied to the subassemblies as shown in figure 7–4.

7–20. PLUS 150-VOLT DISTRIBUTION. The 150-volt regulated supply is obtained from the 250-volt rectifier supply. The output of this supply is connected through pins 13 of J316/P802 to dropping resistor R801 and voltage regulator tube V801. The resultant +150 volts is then applied through pins 14 of J316/P802 to the various subassemblies as shown in figure 7–5.

7–21. REGULATED +108- AND UNREGULATED +120-VOLT DISTRIBUTION. Figure 7–6 shows the +108-regulated and +120 unregulated voltage distribution. As shown in this illustration, the regulated +108 volts is reduced to +9 and +4.2 volts. The +9 volts is used to supply bias to the varicap diodes in the reactance control circuit and the +4.2 volts provides bias for the diodes in the 5- and 50-kc harmonic amplifier circuits in the channelizer subassembly.

7–22. BIAS VOLTAGE DISTRIBUTION. Negative voltage for operation of the various circuits in the receiver-transmitter is provided by the circuit shown in figure 7–3. The 115-volt, 400 cps power source is converted to d-c by CR301 and filtered by the capacitor C311. The resultant negative voltage is then developed across the series connected resistors R313 and R315 through R318. The Zener diode CR302 serves to regulate the negative voltage across the resistance string. Minus 65 volts is tapped off the resistance string and is connected to the subassemblies shown in figure 7–3. Minus 24 volts is connected through the channelizer subassembly to the dual crystal oscillator subassembly provide the required bias for the varicap diodes and to the discriminator subassembly to provide bias for V3401 and V3402. All components of the negative voltage supply are mounted on the main chassis. The bias voltage supply in Power Supply 416W–1 is not used in this equipment.

7–23. RECEIVER-TRANSMITTER CHECK-OUT OR ANALYSIS.

7–24. GENERAL PROCEDURE. When it has been determined in the system check-out that the receiver-transmitter is the malfunctioning component it can be checked by means of the trouble analysis chart of figure 7–9. Reference must be made to figure 2–2 for all major test point locations. Where a replaced subassembly clears the trouble, the receiver-transmitter can be released for use and the defective subassembly checked and repaired as required. Figure 7–9 only aids the technician in tracing the defect to a subassembly. If all subasemblies are performing normally and the trouble persists, then it is necessary to check all interconnecting cables and the main chassis wiring for open or short circuits. In some cases, the fault may be traced to a malfunction in one or more of the chassis mounted relays, or their associated circuit components. These troubles must be traced by making continuity tests with an ohmmeter. Where trouble is traced to no or improper bias on the power amplifier tubes, check the bias rectifier circuit parts located on the main chassis. This circuit also supplies bias voltage

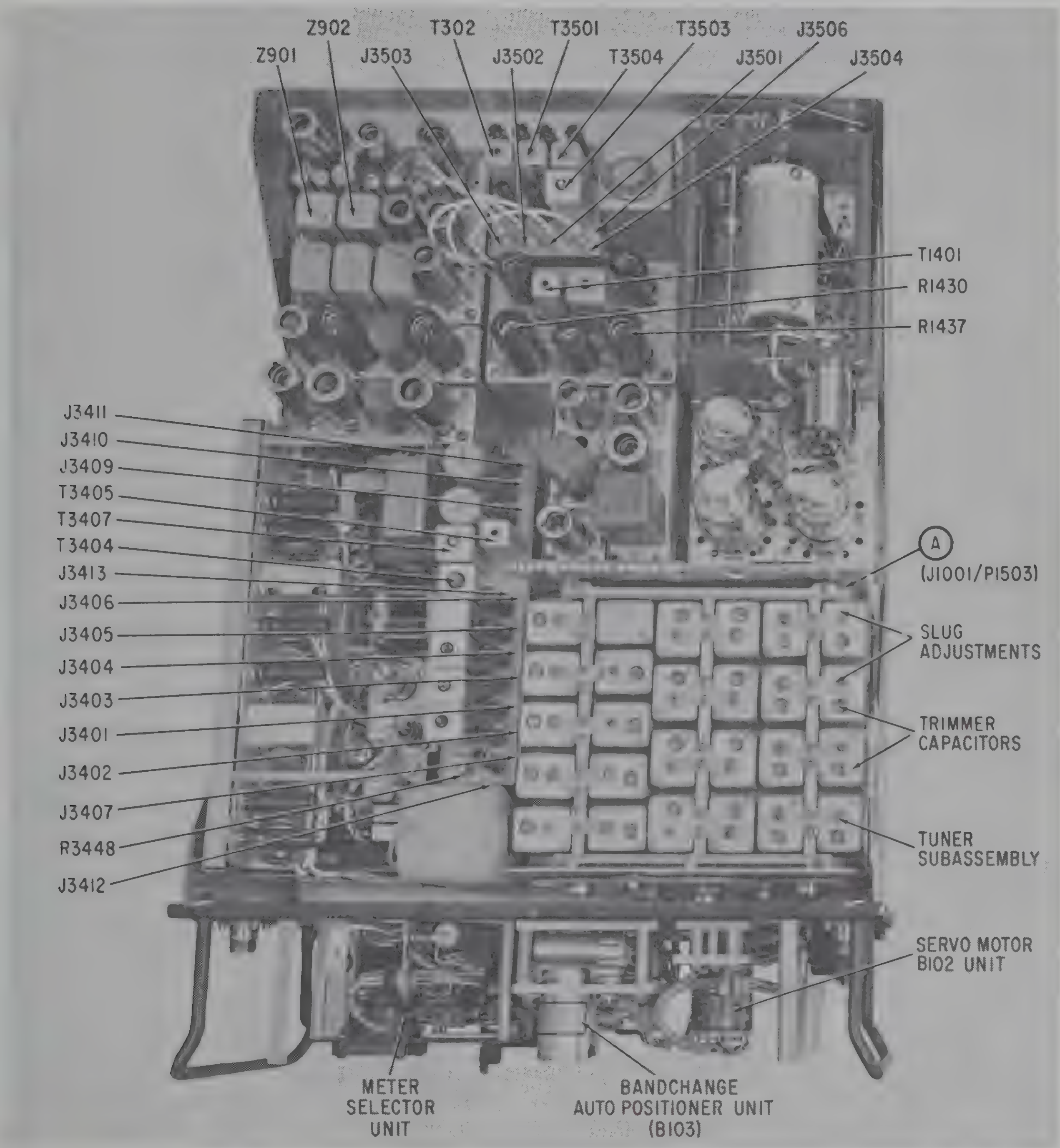


Figure 7–2. Receiver-Transmitter 618S–1/MC Test and Alinement Points, Top View

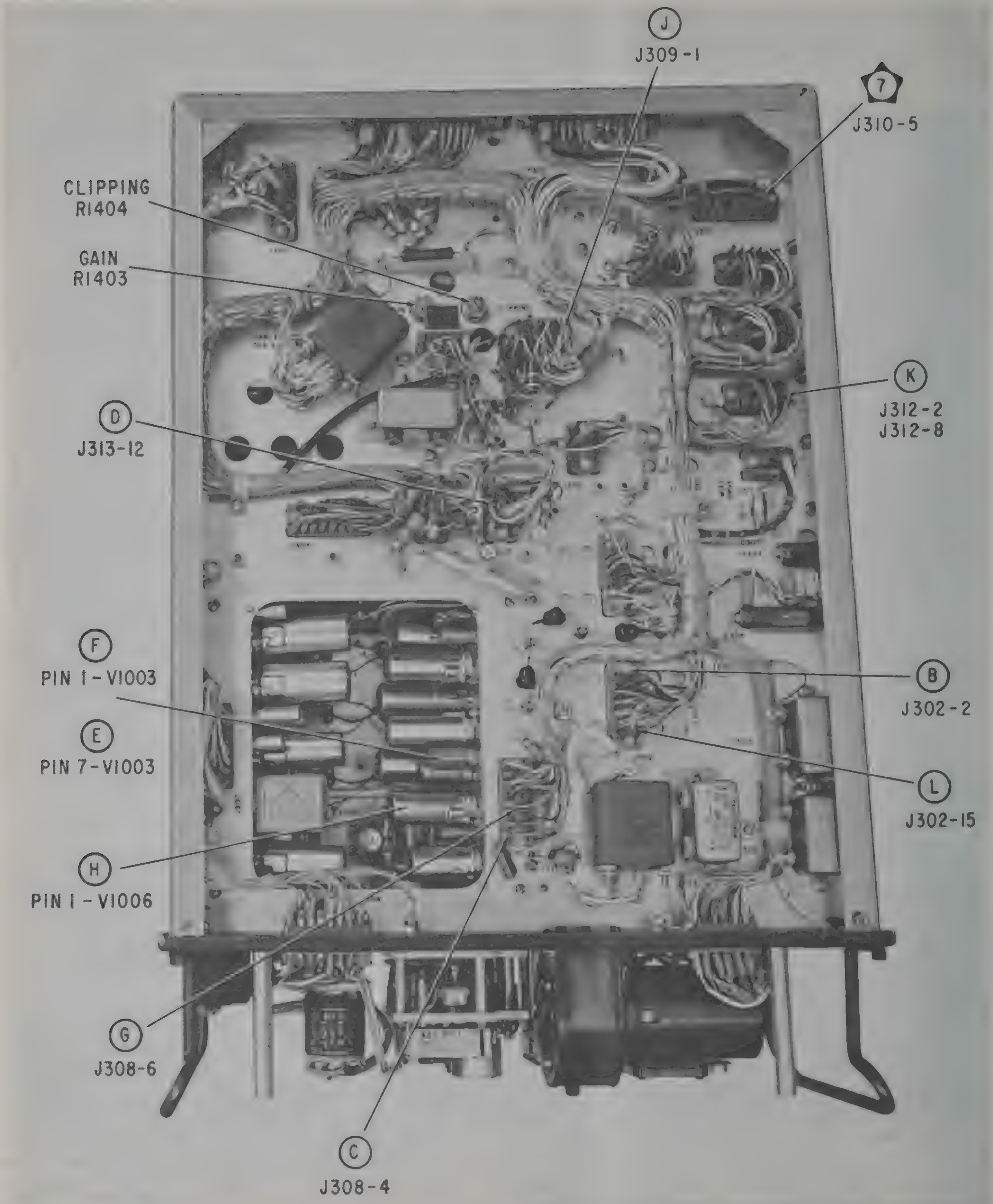
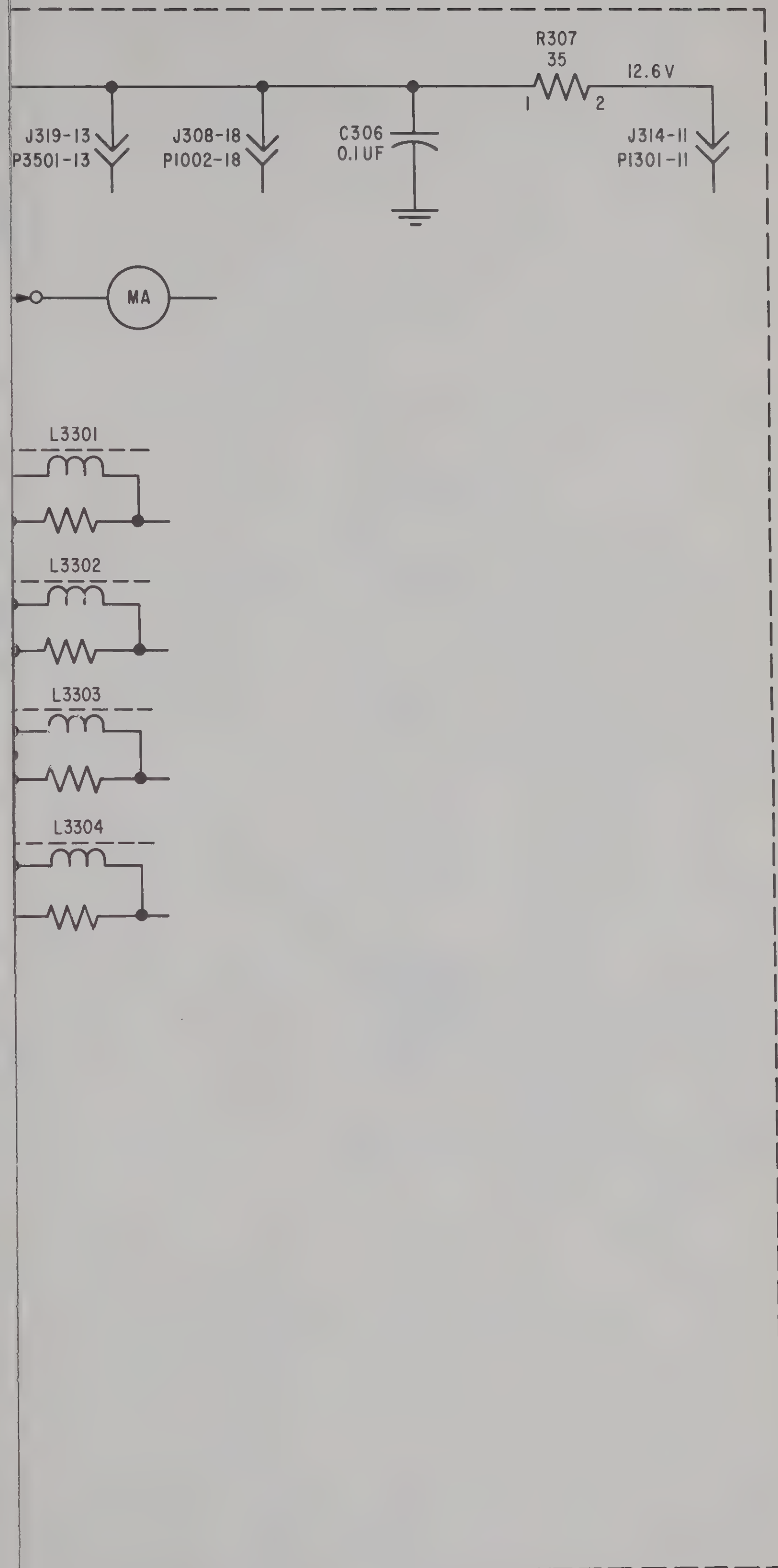


Figure 7–3. Receiver-Transmitter 618S–1/MC Test and Alinement Points, Bottom View



4. Primary Voltage Distribution

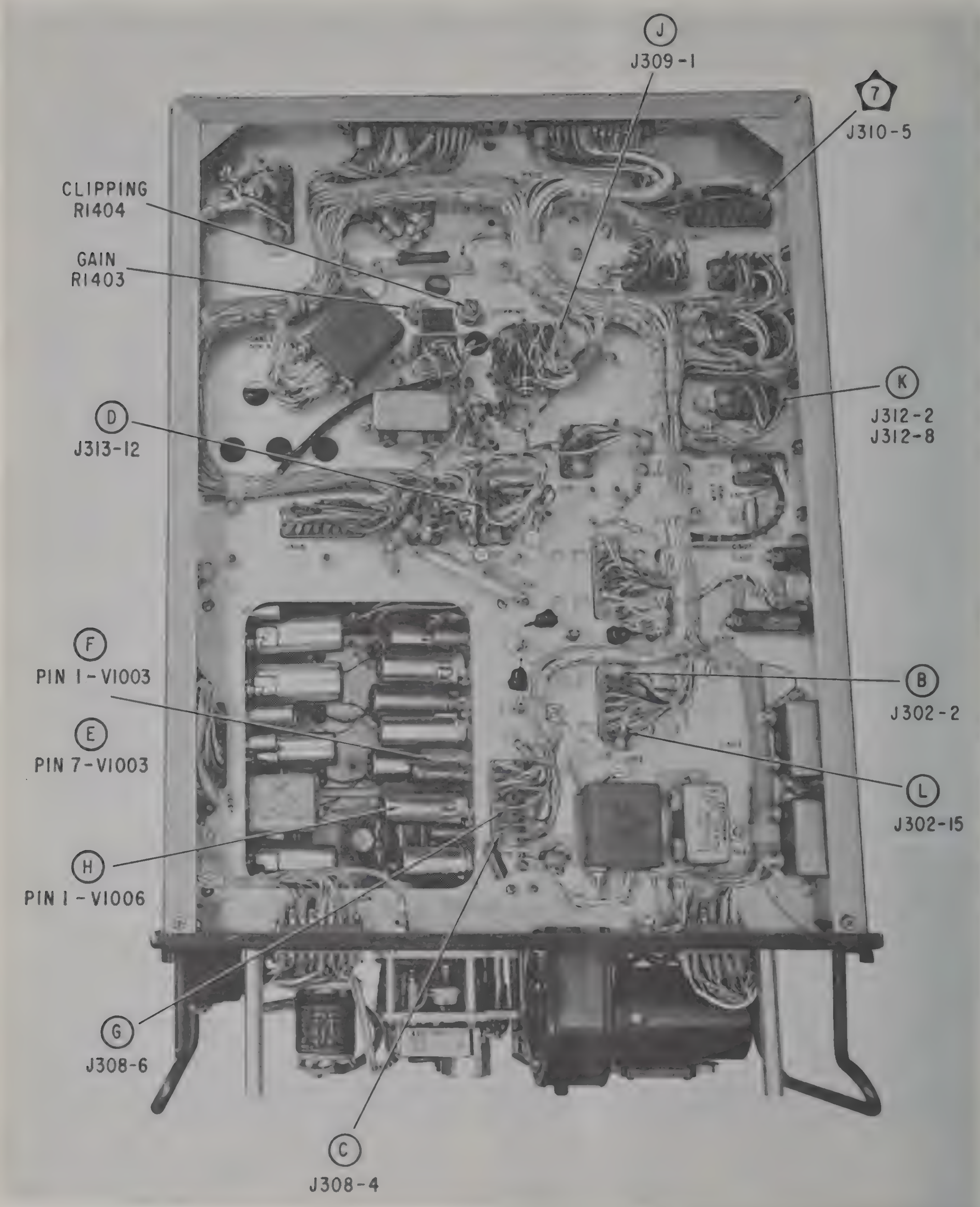


Figure 7–3. Receiver-Transmitter 618S–1/MC Test and Alinement Points, Bottom View

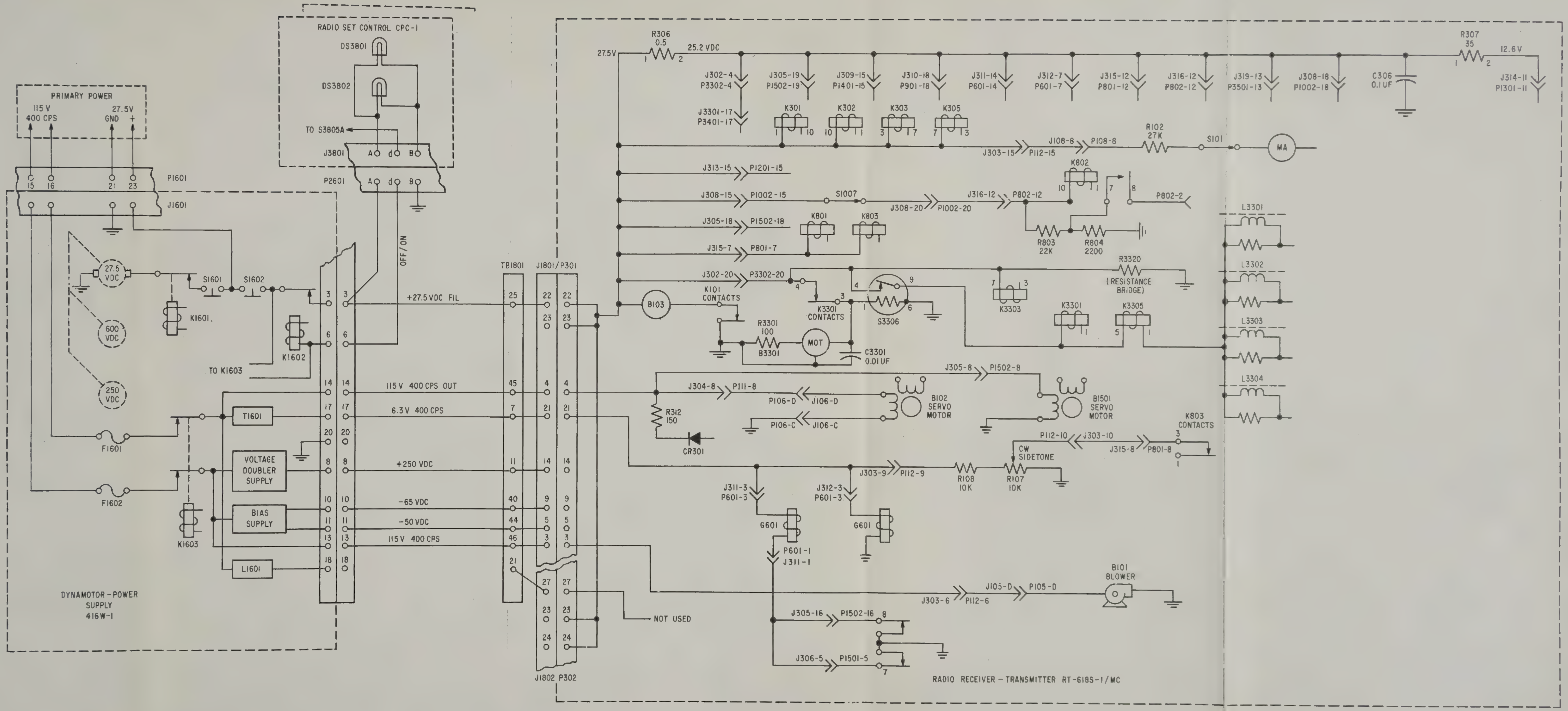


Figure 7-4. Primary Voltage Distribution

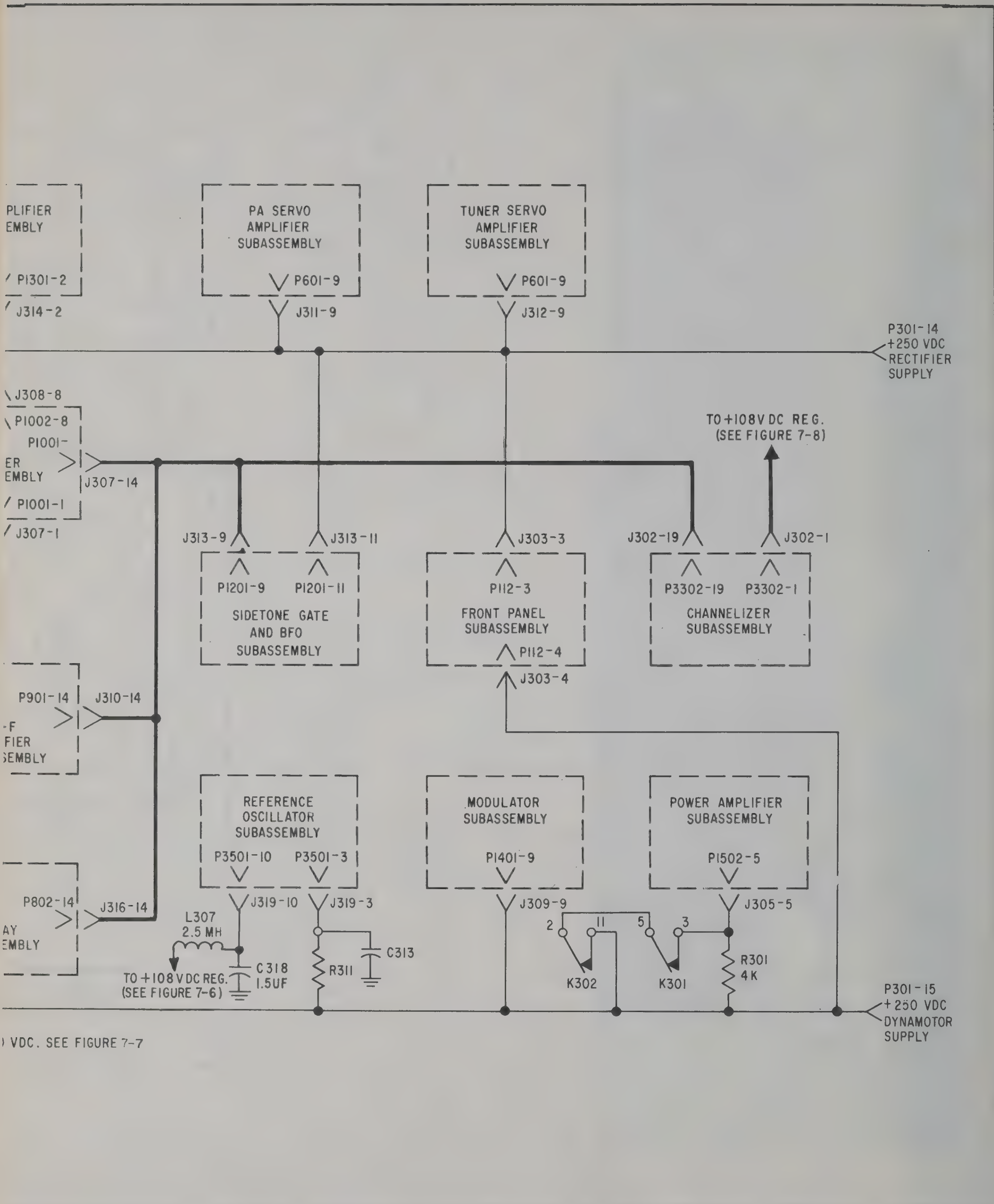


Figure 7–6. Plus 150 and 250-Volt Distribution

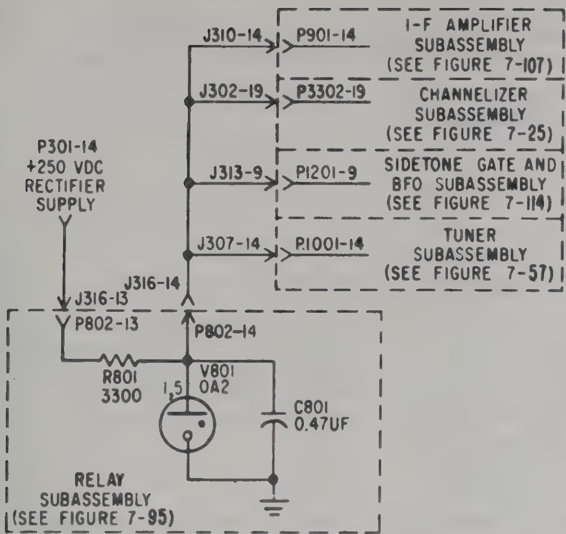


Figure 7-7. Plus 150-Volt Distribution

to the varicap diodes located in the dual oscillator subassembly. Therefore, trouble experienced in the tuning of the equipment could be traced to improper voltage from this bias supply.

7-25. REMOVAL AND REPLACEMENT. Receiver-Transmitter 618S-1/MC consists of a group of twelve subassemblies which plug into receptacles on the main chassis. Two additional subassemblies (the dual crystal oscillator and discriminator subassemblies) plug into receptacles on the controlled master oscillator subassembly. The individual plug-in subassemblies which require mechanical linkage to each other or to the front panel subassembly are constructed with quick-disconnect, flexible Oldham-type couplers to allow removal of the subassemblies from the main chassis. Once these linkages are synchronized, and the proper procedure is followed, it is possible to remove and replace units without additional mechanical alinement. All electrical connections to the plug-in subassemblies and units are made through receptacles on the main chassis which facilitates removal without unsoldering wires. Captive hold-down screws (painted red) secure the individual subassemblies in place. The front panel subassembly is constructed to make good electrical contact with a dust cover that is removable from the rear of the equipment.

7-26. Removal of Dust Cover. Disengage the two Dzus fasteners at the rear of the unit and place the component on the floor with the back plate flat against

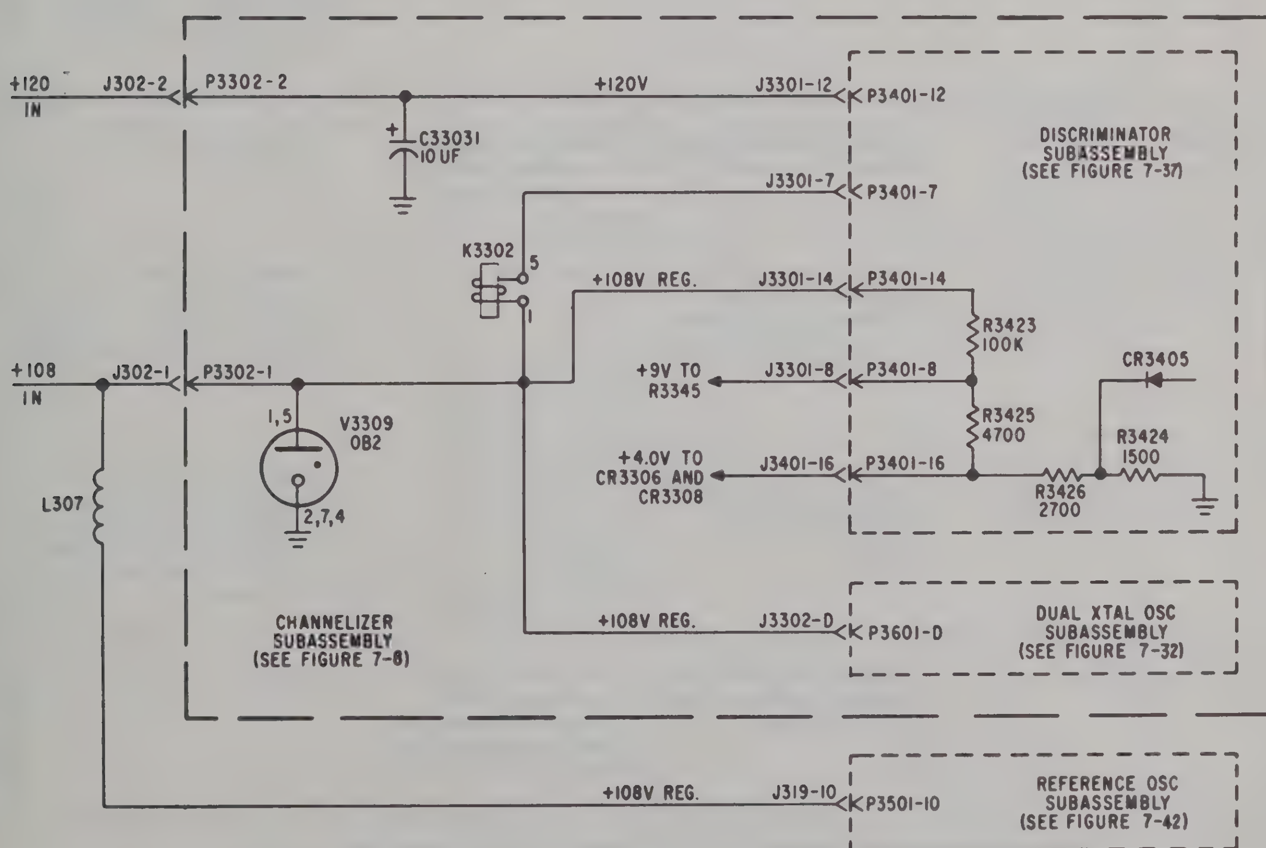


Figure 7-8. Regulated +108 and Unregulated +120-Volt Distribution

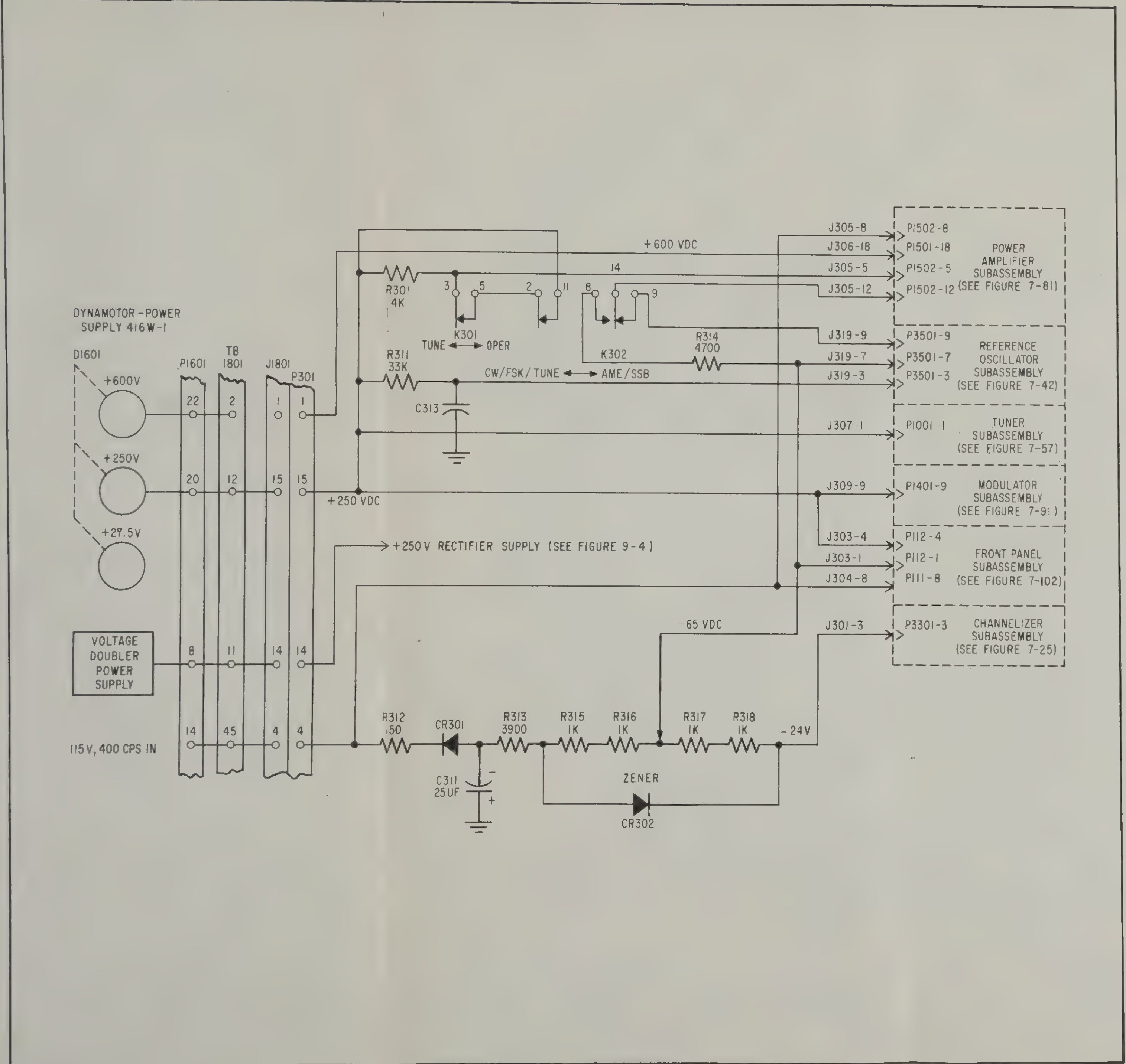


Figure 7–5. Dynamotor B-Plus and Bias Distribution

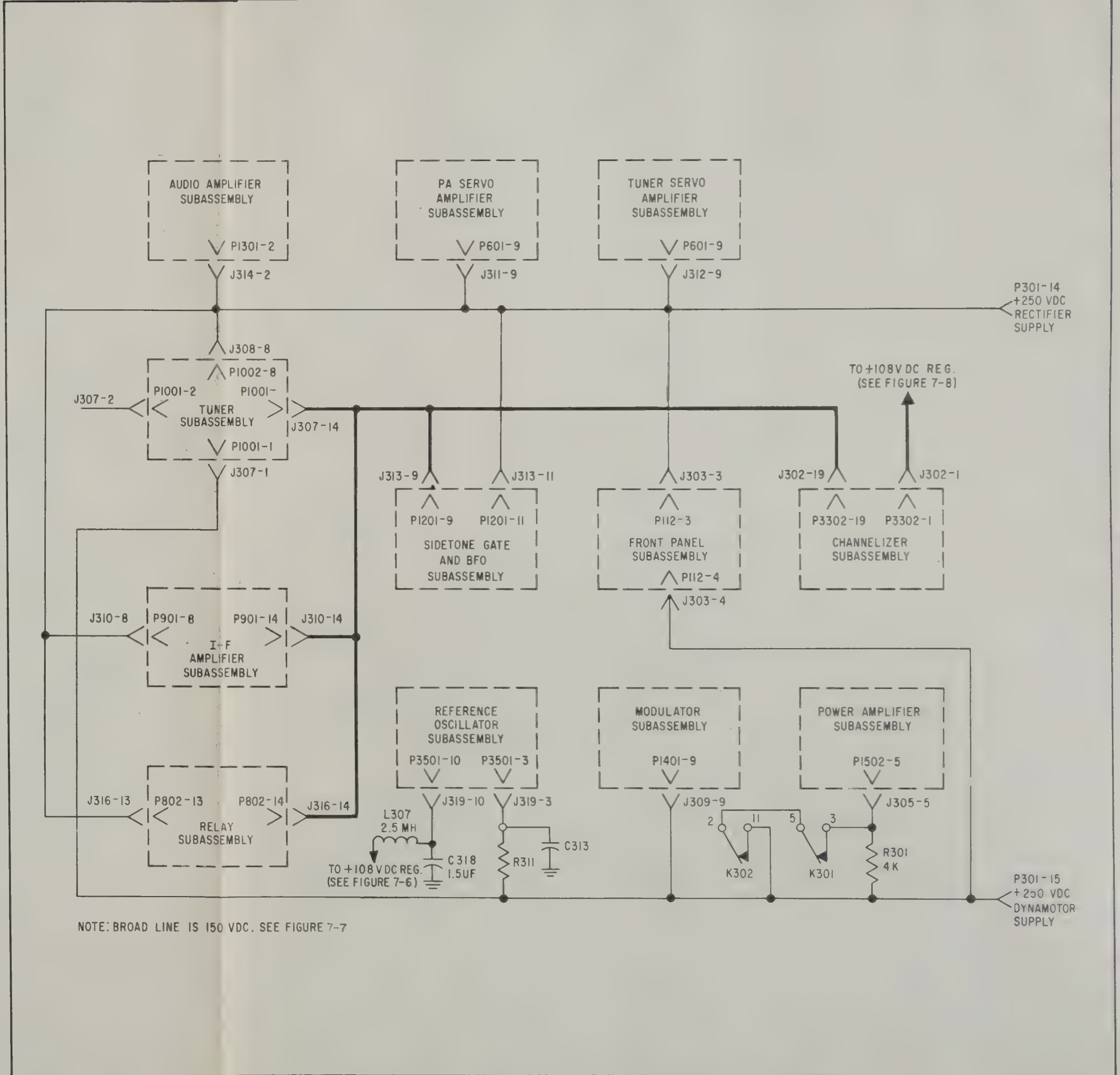


Figure 7–6. Plus 150 and 250-Volt Distribution

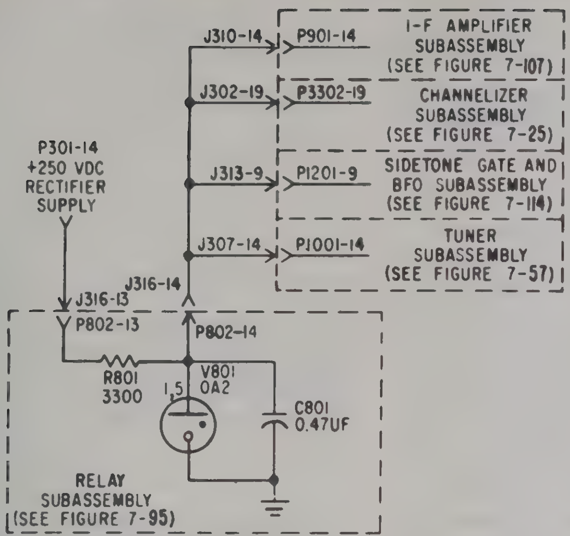


Figure 7–7. Plus 150-Volt Distribution

to the varicap diodes located in the dual oscillator subassembly. Therefore, trouble experienced in the tuning of the equipment could be traced to improper voltage from this bias supply.

7–25. REMOVAL AND REPLACEMENT. Receiver-Transmitter 618S–1/MC consists of a group of twelve subassemblies which plug into receptacles on the main chassis. Two additional subassemblies (the dual crystal oscillator and discriminator subassemblies) plug into receptacles on the controlled master oscillator subassembly. The individual plug-in subassemblies which require mechanical linkage to each other or to the front panel subassembly are constructed with quick-disconnect, flexible Oldham-type couplers to allow removal of the subassemblies from the main chassis. Once these linkages are synchronized, and the proper procedure is followed, it is possible to remove and replace units without additional mechanical alinement. All electrical connections to the plug-in subassemblies and units are made through receptacles on the main chassis which facilitates removal without unsoldering wires. Captive hold-down screws (painted red) secure the individual subassemblies in place. The front panel subassembly is constructed to make good electrical contact with a dust cover that is removable from the rear of the equipment.

7–26. Removal of Dust Cover. Disengage the two Dzus fasteners at the rear of the unit and place the component on the floor with the back plate flat against

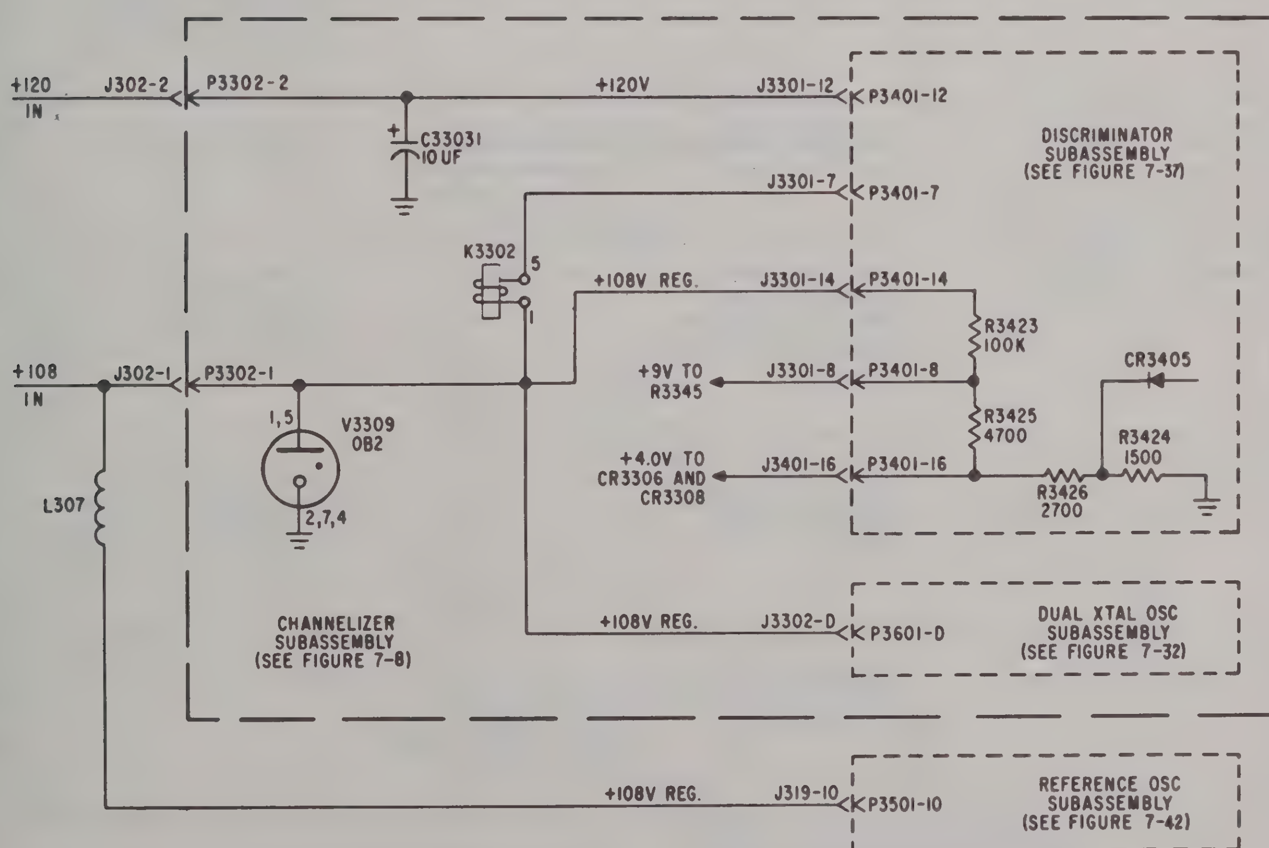


Figure 7–8. Regulated +108 and Unregulated +120-Volt Distribution

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
1	Visual	None	Operate the function switch on Radio Set Control CPC–1 to the "AME" position and allow 10 minutes for warmup. Then set switch to "CW" position.	Tube filaments light; blower B101 and dynamotor operates.	Proceed to step 2.
2	9 TB1801	Multimeter TS–352/U	Measure the voltage at each of the following TB1801 terminals: 2, 7, 11, 12, 25, 40, 44, 45, and 46	2, 600 vdc; 7, 6.3 vac; 11, 250 vdc; 12,250 vdc (transmit) 25, 27.5 vdc; 40, —65 vdc; 44, —50 vdc; 45, 115 vac; 46, 115 vac.	Check power supply as outlined in figure 9–3, filter unit, (see figure 7–125), or main component for abnormal loading.
3	1 (E102 or J110) 2	Bird Model 82 Dummy Load and Frequency Meter AN/USM–26.	Refer to note following paragraph 2–10 and tune equipment to several random frequencies. Note if frequency as read on frequency meter corresponds to letter code.	Readings should correspond to letter code of selected frequencies.	Replace channelizer subassembly. If after replacement, normal tuning is accomplished, check replaced subassembly (figures 7–16 and 7–17). If incorrect tuning is still present, replace Radio Set Control CPC–1 and tuner subassembly one at a time and repeat test. Where this clears the fault, check radio set control as outlined in Section VIII and tuner subassembly as outlined in paragraph 7–115. Proceed to step 4 if fault persists.
4	Visual	None	Repeat step 3 and observe tuner subassembly.	Tuner slugs should center and then move to the setup position.	Proceed to step 5
5	Visual	None	Replace the tuner subassembly with one known to be in good operating condition and repeat step 3.	Same as step 4.	Trouble is in tuner or relay subassemblies. Check as shown in figure 7–44 and paragraph 7–199. If trouble persists, proceed to step 6.
6	Visual	None	Replace servomotor B102 with a normally operating unit and repeat step 3.	Same as step 4.	Trouble is in servomotor B102, or tuner servo amplifier subassembly. Check as shown in figure 7–96 and paragraph 7–153. If trouble persists proceed to step 7.
7	Visual	None	Repeat step 3 and observe tuning in power amplifier subassembly.	The roller of main tuning inductor L1502 should table and then move to the setup position.	Proceed to step 8.

Figure 7–9. Trouble Analysis Chart for Receiver-Transmitter 618S–1/MC (Sheet 1 of 4)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
8	Visual	None	Replace power amplifier subassembly and repeat step 3.	Same as step 7.	Trouble is in replaced subassembly if operation is normal. Check as shown in figure 7–75. Proceed to step 9.
9	Visual	None	Replace pa servo amplifier subassembly and repeat step 3.	Same as step 7.	Trouble is in replaced subassembly if operation is normal. Check as shown in figure 7–76 and paragraph 7–174. If the trouble persists proceed to step 10.
10	Visual	None	Select several frequencies in each band and observe the band-change switches of the tuner and power amplifier subassembly.	Switches rotate and select the correct band of operation.	Proceed to step 11.
11	Visual	None	Replace band change auto positioner unit with one known to be in good operating condition and repeat step 10.	Same as step 10.	Trouble is in replaced unit, or in Radio Set Control CPC–1.
12	3 (J109) 4 (J101)	Signal Generator AN/URM–25, Output Meter TS–585B/U, and Frequency Meter AN/USM–26.	Perform steps a through i of paragraph 2–18 for one frequency of each band.	100 milliwatts and signal-plus-noise-to-noise ratio of 6 db.	Proceed to step 13.
13	Same as step 12.	Same as step 12.	Replace Radio Set Control CPC–1 with one known to be good and perform steps a through i, paragraph 2–18 for one frequency on each band.	Same as step 12.	Trouble is in replaced radio set control or channelizer band change relay K3303. Check as outlined in Section VIII for the radio set control and paragraph 7–37 for the channelizer subassembly. Proceed to step 14.
14	Same as step 12.	Same as step 12.	Replace the channelizer subassembly and perform steps a through i of paragraph 2–18 for one frequency on each band.	Same as step 12.	Proceed to step 15.
15	Same as step 12.	Same as step 12.	Replace the tuner subassembly and perform steps a through i of paragraph 2–18 for one frequency in each band.	Same as step 12.	Proceed to step 16.
16	Same as step 12.	Same as step 12.	Replace the i-f amplifier subassembly and perform steps a through i of paragraph 2–18 for one frequency in each band.	Same as step 12.	Proceed to step 17.

Figure 7–9. Trouble Analysis Chart for Receiver-Transmitter 618S–1/MC (Sheet 2 of 4)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
17	Same as step 12.	Same as step 12.	Replace audio amplifier subassembly and perform steps a through i of paragraph.	Same as step 12.	Trouble is in "AUX REC ANT", or "PHONE" jacks, or interconnecting wires.
18	3 (J109) 4 (J101)	Signal Generator AN/URM–25, Output Meter TS–585B/U, Frequency Meter AN/USM–26, Headset H–1/AR or H–4/AR.	Set the signal generator frequency to 2.75 mc with the frequency meter and connect the signal generator to test point 3. Perform step j of paragraph 2–18.	100 milliwatts and signal-plus-noise to noise ratio of 10 db.	Proceed to step 19.
19	Same as step 18.	Same as step 18.	Replace the reference oscillator subassembly.	Same as step 18. Proceed to step 20.	If replaced subassembly clears fault check for defect as outlined in paragraph 7–105 and 7–239.
20	Same as step 18.	Same as step 18.	Perform steps k through n of paragraph 2–18.	100 milliwatts at 1,000 cycles.	Proceed to step 21.
21	Same as step 18.	Same as step 18.	Replace modulator subassembly and perform steps k through n of paragraph 2–18.	Same as step 20.	If replaced subassembly clears fault, check as outlined in figure 7–87. If fault persists proceed to step 22.
22	Same as step 18.	Same as step 18.	Replace reference oscillator subassembly and perform steps k through n of paragraph 2–18.	Same as step 20.	If replaced subassembly clears fault, check as shown in figure 7–39. Proceed to step 23.
23	1	Bird Model 82 Dummy Load and VTVM TS–375/U	Perform steps a through g of paragraph 2–13.	70-volts rms.	Proceed to step 24.
24	Same as step 23.	Same as step 23.	Replace channelizer, tuner, pa, reference oscillator, modulator, and relay subassemblies one at a time, repeating the tests in steps a through g of paragraph 2–13 after each replacement.	Same as step 23.	If any replaced subassembly clears fault, check as shown in figures 7–16, 7–17, 7–44, 7–112, 7–87, 7–95, respectively.
25	Same as step 23.	Same as step 23.	Perform steps a through g of paragraph 2–14.	100 percent modulated waveform with minimum peak clipping and 50-volts rms.	Proceed to step 26.
26	Same as step 23.	Same as step 23.	Perform steps h through k of paragraph 2–14.	Same as step 25.	If component performs normally while performing the check in step 23, but fails in this test, replace modulator, reference oscillator, and relay subassemblies, and Radio Set Control CPC–1 one at a time, performing the tests after each replacement.

Figure 7–9. Trouble Analysis Chart for Receiver-Transmitter 618S–1/MC (Sheet 3 of 4)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
27	Same as step 23.	Same as step 23.	Perform steps a through g of paragraph 2–15.	100 percent modulated waveform with minimum of clipping and 50-volts rms.	Proceed to step 28.
28	Same as step 23.	Same as step 23.	Replace modulator, reference oscillator, and relay subassemblies, and Radio Set Control CPC–1 one at a time, performing the tests of paragraph 2–15 after each replacement.	Same as step 27.	If any replaced subassembly clears fault, check respective unit as shown in figures 7–87, 7–39, 7–95, and 8–1, respectively.
29	4	Same as step 23 plus Headset H–1/AR or H–4/AR.	Perform steps a through f of paragraph 2–16.	Variable sidetone signal heard in headset.	Proceed to step 30.
30	Same as step 29.	Same as step 29.	Replace bfo and sidetone gate, audio amplifier, i-f amplifier, and relay subassemblies one at a time, performing the tests of paragraph 2–16 after each replacement.	Same as step 29.	If any replaced subassembly clears fault, check respective unit. If the trouble persists, replace power amplifier subassembly and Radio Set Control CPC–1. Check the sidetone rectifier circuit in the power amplifier subassembly and the function switch in the radio set control.

Figure 7–9. Trouble Analysis Chart for Receiver-Transmitter 618S–1/MC (Sheet 4 of 4)

the floor. The main chassis can then be lifted out of the case by pulling straight up on the two handles. It is not necessary to fit the main chassis into a jig for test purposes, since all plug-in subassemblies are accessible from the top and the unit will set flat on the bench.

7–27. Removal of Subassemblies, General. In order to aid the technician in removing a subassembly, the screws which secure the subassembly are painted red. They must be loosened to free the subassembly but should not be removed completely. It is important that a Phillips-head screwdriver of the proper size be used to prevent damage to the heads of the screws. When the screws are loosened, they cause some extraction of the plugs which connect the subassemblies to the main chassis. This is desirable as it prevents damage to the pins during removal. It is important to rock the subassemblies loose as they are extracted from the chassis. Insert the plugs carefully when returning subassemblies to the main chassis, checking for proper alinement between the plugs and receptacles. Removal and replacement details for each subassembly are given following the respective check-out or analysis procedure.

7–28. ALINEMENT AND ADJUSTMENT PROCEDURES. The procedures and tools required for precision alinement and adjustment of the overall receiver-transmitter are described in the following paragraphs. Alinement and adjustment procedures for the various subassemblies are to be accomplished as described following each subassembly check-out or analysis paragraph. When all alinement and adjustment procedures have been completed, the receiver-transmitter should be subjected to the detailed performance tests outlined in paragraphs 6–9 and 7–16. All alinement and adjustment procedures are to be performed with the equipment connected in the bench test setup as described in paragraphs 2–6 and 6–6.

7–29. Alinement Equipment. If Test Set 478H–1 (modified) is available to field maintenance personnel, it should be used throughout the trouble analysis and alinement procedures to be described. The test set was redesigned for testing and alinement of the plug-in subassemblies of Radio Receiver-Transmitter 618S–1/MC. The 478H–1 consists of a chassis with a main panel, on which are mounted receptacles which mate with the plugs of the subassemblies. The 478H–1 provides a "go-no go" method of checking with the sub-

assemblies removed from the main chassis. Also most of the subassemblies can be alined while removed from the main chassis. The test set is designed to operate with Power Supply 413F-1, which provides all power necessary for operation of the removed subassemblies and the 478H-1. Complete operating procedures are supplied with the test set and power supply.

7–30. A maintenance kit for this equipment is designed for use with the test set in order to simplify trouble analysis and alinement procedures. The maintenance kit includes three tube adapters, a gauge block, a dial gauge, an alinement tool, and a test kit case for shipment and storage of the aforementioned items. If both the maintenance kit and the test set are available, the procedures to follow will be simplified greatly. Where the test set is not available, the subassemblies can be checked with power supplied by the use of extension cables for the respective subassemblies. The extension cables are illustrated in figures 3–6 through 3–11 and can be fabricated from bulk supplies as shown. Refer to paragraph 3–7 for all fabrication details.

7–31. Where the maintenance kit is not available, it is necessary to make a gauge block of nonmagnetic metal, exactly 1.375 inches wide and thin enough to slide between the coil shields of the tuner subassembly, and long enough to be placed under the tuning rack. This gauge block is required for alinement of the tuner subassembly. Also, it is necessary to have a dial gauge. The dial gauge must be capable of measuring from 0 to 0.798 inch, and should be mounted on a clamp bracket for securing to the rear plate of the tuner subassembly. The placement and use of the gauge block and dial gauge will be described in paragraphs 7–122 through 7–124.

7–32. Final Adjustments. The adjustment procedures of this paragraph and paragraphs 7–33 and 7–34 should always be performed after a repair, realinement, or adjustment has been made to any of the subassemblies. The final adjustments consist of setting the audio, phone, cw sidetone, and sensitivity controls of Receiver-Transmitter 618S–1/MC. These controls are located on or near the sidetone control unit of the front panel subassembly. Access to these controls can be attained by removing the four screws securing the front panel in place and removing the front panel. Proceed as follows to adjust the audio control.

a. Rotate "SENS" control (R116) to approximate maximum clockwise position.

Note

In general, set R116 as near to maximum as noise background on noisiest channel will permit.

b. Connect the radio set in a test bench setup. Refer to figure 2–2.

c. Connect Output Meter TS–585B/U to J101 (test point 4). Adjust to the 500-milliwatt range with an internal impedance of 300 ohms.

d. Connect Signal Generator AN/URM–25 to J109 (test point 3). Adjust to 1000 microvolts at 2.0 megacycles, modulated 30% at 1000 cps. Use Frequency Meter AN/USM–26 to set the AN/URM–25 frequency properly.

e. Operate the Radio Set Control CPC–1 volume control to the maximum clockwise position.

f. Operate the function switch to the "AME" position and allow at least 10 minutes for warmup.

g. Select the channel corresponding to 2.0 megacycles ("BKBB").

h. Adjust R109 for an indication of approximately 300 milliwatts on Output Meter TS–585B/U.

7–33. Proceed as follows to adjust the "CW" sidetone control.

a. Connect the dummy load to E102 or J110 as illustrated in figure 2–2.

b. Perform steps a, b, e, and f of previous paragraph.

c. Insert a microphone into J101 or a telegraph key into J103.

d. Operate the function switch to the "CW" position.

e. Depress the telegraph key or microphone push-to-talk button.

f. Adjust R107 for an indication of approximately 300 milliwatts on Output Meter TS–585B/U.

7–34. Proceed as follows to adjust the "PHONE" sidetone control.

a. Connect the dummy load and Oscilloscope TEK–545 to E102 or J110 (test point 1). See figure 2–2.

b. Connect the dummy microphone (figure 3–2) to J102 (test point 5).

c. Connect Audio Oscillator TS–382A/U to the dummy microphone, as illustrated in figure 2–2.

d. Perform steps a, b, e, and f of paragraph 7–32.

e. Adjust Audio Oscillator TS–382A/U to 1000 cps. Set the level to that necessary for 100% modulation as observed on the oscilloscope.

f. Adjust R106 for an indication of exactly 300 milliwatts on Output Meter TS–585B/U.

7–35. SUBASSEMBLY CHECK-OUT OR ANALYSIS.

7–36. GENERAL. The following trouble analysis procedures are a continuation of the trouble analysis procedures outlined in figures 6–2 and 7–9. Isolation of a defect to a detail part within any of the subassemblies is accomplished by means of individual subassembly trouble analysis procedures. Before proceeding to the steps outlined in the individual subassembly procedures, trouble should be known to exist within the suspected subassembly. This can be verified by substituting a similar subassembly known to be in good

operating condition in the receiver-transmitter, or by performing the minimum performance checks provided for each subassembly. Also make certain all voltages are present as indicated in step 2 of figure 7–9. If a malfunction is present in the filament circuits, refer to paragraph 6–3 before replacing any tubes or making a repair.

7–37. CHANNELIZER SUBASSEMBLY.

7–38. CHANNELIZER SUBASSEMBLY DATA. The channelizer subassembly is comprised of three separate subassemblies. These are: (1) the dual crystal oscillator subassembly; (2) the discriminator subassembly; and (3), the channelizer subassembly itself. The dual crystal oscillator and discriminator subassemblies plug into the chassis of the channelizer subassembly. Also mounted on the chassis of the channelizer subassembly are the controlled master oscillator (cmo), buffer amplifier, 500-kc, 50-kc, and 5-kc harmonic amplifiers, and three mixer stages. The output of the third mixer stage is coupled to the input circuit of a doubler stage located in the discriminator subassembly where further mixing with the outputs of the dual crystal oscillator subassembly and the reference oscillator subassembly is accomplished. The resultant output of the various combinations of frequencies in the discriminator subassembly is then compared with the 100-kc sawtooth output of the reference oscillator subassembly in the phase detector circuit, the output of which provides the voltage required to automatically resonate the cmo to the desired frequency. The electromechanical tuning mchanism required to automatically resonate the cmo and select the proper harmonics of the harmonic amplifiers is also contained in the channelizer subassembly. The various harmonics are switch selected and tuning of the cmo is accomplished by means of selection of the correct shunt capacitors and a variable capacitor which is driven by a motor. The motor is mechanically coupled to the shafts of the various selector switches and also the tuning control switches. Tuning is accomplished by closing ground circuits to the coils of clutch solenoids which control the rotation of the respective switch shafts. When current flows through the coil of any one or combination of the clutch solenoids, the respective relays are energized and the motor will rotate the selector switch shafts until an open circuit to ground is reached. When this occurs, the respective solenoid will be deenergized and the clutch will slip (while the shaft is stationary) until the motor ceases to run. The motor will continue to run until the variable capacitor is set to the exact cmo frequency required to obtain the selected transmitter or receiver operating frequency. This setting is reached when the difference voltage and the phase at the output of the phase detector is zero.

7–39. DUAL CRYSTAL OSCILLATOR SUBASSEMBLY DATA. This subassembly plugs into, and must be considered a part of, the channelizer subassembly as it is an integral part of the tuning control circuits. Each section of a dual triode tube is used as a crystal controlled oscillator. The output frequency of the B section of the tube is controlled by any one of ten switch selected crystals within the range of 330 to 339 kc in 1-kc increments. The output frequency of the A section is controlled by any one of four relay selected crystals within the range of 200.0 to 200.75 kc in 250-cycle increments. All crystals are mounted in a temperature controlled oven in order to compensate for variations in temperature. In order to obtain exact frequency output, varicap diodes are used to shunt the input circuit of each oscillator. Bias for operation of the varicap diodes is obtained from a voltage divider connected across a —24-volt tap of the main chassis mounted negative voltage supply. Regulation of the —24 volts is accomplished by means of a Zener diode located in the dual crystal oscillator subassembly. As each crystal is switched into the circuit, the respective varicap diodes are connected to the factory selected taps on the voltage divider. This assures correct frequency output, as the varicap diodes will compensate for slight variations in the crystal frequencies.

7–40. DISCRIMINATOR SUBASSEMBLY DATA. The discriminator subassembly is mounted on the channelizer subassembly and can be considered an integral part of the latter as it contains the electronic control circuitry for tuning of all of the low level circuits. Two mixers, a divider-mixer, a doubler, a tripler, three locked oscillators, a phase inverter, three cathode followers, a phase detector, and a relay control stage are mounted on this unit. One mixer is used to combine the outputs of the dual crystal oscillator subassembly with the resultant output frequency mixing in the second mixer with the output of the doubler. The doubler is driven by the output of the third mixer in the channelizer subassembly (see paragraph 7–38). The output of the second mixer is used to drive the divider-mixer which is coupled to the phase inverter. The latter's output is then compared in the phase detector with the 100-kc sawtooth output of the reference oscillator subassembly. Any difference voltage output is then coupled through the cathode follower stage to the relay control stage (drive motor fine tuning control) and the varicap diodes used to shunt the tank circuit in the cmo (see paragraph 7–66). The three locked oscillator stages are connected in cascade to step the 100-kc sine wave signal from the reference oscillator subassembly down to the 5-kc and 50-kc signals required to drive the 5-kc and 50-kc harmonic amplifiers located in the channelizer subassembly.

7–41. When trouble is experienced in the frequency selection circuits always check the channelizer, dual crystal oscillator, discriminator, and reference oscillator subassemblies in accordance with their minimum performance standards outlined in paragraphs 7–42,

7–45, 7–46, and 7–105, respectively. If trouble is present in any of these units, check the malfunctioning subassembly in accordance with the procedures outlined in paragraphs 7–49, 7–84, 7–93, and 7–108.

7–42. MINIMUM PERFORMANCE STANDARDS. When performing the following checks, the channelizer subassembly must be removed from the main chassis and reconnected to the two chassis receptacles by means of two 20-pin extension cables and plugs. (Removal procedures for the channelizer subassembly are outlined in paragraph 7–52.) The dual crystal oscillator and discriminator subassemblies must be mounted on the channelizer, and the reference oscillator subassembly must be in place on the main chassis. All tests are to be performed in the bench test setup shown in figure 2–2. The following checks should be performed whenever a repair or replacement has been made.

7–43. Frequency Selection Tests. It is not necessary to key the transmitter while performing these checks.

a. Connect Frequency Meter AN/USM–26 to pin 15 of P3302/J302 (test point L).

b. Connect vertical probe of Oscilloscope TEK 545 to "J3406".

c. Apply power to all equipment and allow a minimum of 10-minutes warmup time before proceeding.

d. Set "CHANNEL" select switches on Radio Set Control CPC–1 to "BKBB". A reading of 1750 kc ± 3.2 cycles should be observed on the frequency meter.

e. Adjust oscilloscope controls so that several sawtooth patterns are visible similar to those of figure 7–10. A phase sampling pip should be evident at two-thirds to three-quarters the way up the slope of each sawtooth as shown in the figure. This phase lock pattern should be 15 to 20 volts peak-to-peak.

f. Connect vtvm probe to "J3413". A reading between 5.0 and 8.0 volts dc should be obtained.

g. Disconnect AN/USM–26 from pin 15 of P3302 and connect vtvm probe to this point. A reading of 5 to 6 volts rms should be obtained.

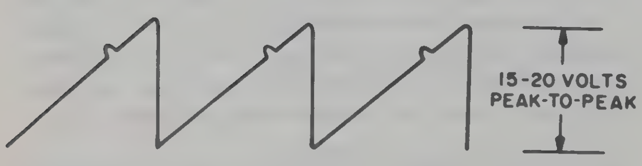


Figure 7–10. Typical Phase Lock Pattern

Note

Always disconnect AN/USM–26 when making voltage checks or the measurements will be in error.

h. Connect the vtvm probe to "J3402". A reading of 2.3 to 10 volts rms should be obtained.

i. Connect vtvm probe to "J3413". A maximum ripple voltage of 0.003 volt rms should be measured at all frequencies.

j. Repeat steps a through i for the frequencies listed in figure 7–11. Refer to note following paragraph 2–10 before proceeding.

CPC–1 Dial Code	Output Frequency	Tolerance (±Cycles)
BKBB	1750.0	3.2
VLWK	1833.75	3.2
BMZZ	1899.875	3.3
CBBB	1900.0	3.3
CGXJ	2138.25	3.4
CGLP	2140.625	3.4
CHHS	2176.625	3.4
*CMZZ	2399.875	3.6
DBBB	2400.0	3.6
DDPD	2506.25	3.7
DMZZ	2899.875	3.9
FBBB	2900.0	3.9
FDSV	3017.875	3.9
FFTK	3073.75	3.9
SJZL	3249.25	4.0
FLBB	3300.0	4.0
FLDG	3312.0	4.0
FLZZ	3349.875	4.0
FMBB	3350.0	4.0
FMZZ	3399.875	4.1
GBBB	3400.0	4.1
GCZZ	3499.875	4.1

* Voltage measurement at J3413 in step f, paragraph 7–43 should be 6.4 to 6.8 volts dc.

Figure 7–11. Channelizer Subassembly Test Frequency Data

7-44. Band Change Tests. The following tests must be made with the transmitter keyed so the output frequencies can be monitored. Make certain the receiver-transmitter used to make the tests is performing normally before proceeding.

a. Connect Frequency Meter AN/USM-26 through a 1-megohm resistor to dummy load.

b. Operate "CHANNEL" select switches on the radio set control to "BKBB". A frequency of 2000 kc ± 3 cycles should be measured when the transmitter is keyed.

c. Repeat step b for each of the frequencies listed in figure 7-12. Refer to note following paragraph 2-10 before proceeding.

CPC-1 Dial Code	Output Frequency	Tolerance (± Cycles)	Band
BKBB	2000.0	3.3	1
GCMM	3749.5	4.1	1
HKBB	3750.0	6.4	2
MCZM	7249.5	8.2	2
NKBB	7250.0	13.2	3
TCZZ	14,249.5	14.7	3
VKBB	14,250.0	25.6	4
YFYK	25,000.0	26.7	4

Figure 7-12. Band Change Frequency Check Data

7-45. Dual Crystal Oscillator Subassembly Test. The dual crystal oscillator subassembly output frequencies can be checked as follows:

a. Connect Frequency Meter AN/USM-26 to "J3407" on the discriminator subassembly.

b. Set "CHANNEL" select switches on the radio set control to "BKBB". Measured frequency should be 200.0 kc.

c. Move frequency meter connection to "J3408" on discriminator subassembly. Measured frequency should be 330 kc.

d. Set radio set control switches to "GMZZ". With frequency meter connected to "J3408", frequency should be 339 kc.

e. Connect frequency meter to "J3407". Frequency should be 200.75 kc.

CPC-1 Dial Code	J3401		J3402		J3407		J3408	
	KC	RMS Volts	KC	RMS Volts	KC	RMS Volts	KC	RMS Volts
BKBB	235.0	1.52	470.0	6.70	200.0	0.95	330	1.45
VLWK	231.25	2.60	462.5	8.10	200.5	0.95	337	1.45
BMZZ	230.125	1.42	460.25	6.40	200.75	0.95	339	1.45
CBBB	235.0	1.80	470.0	7.00	200.0	0.95	330	1.45
CGXJ	231.75	2.45	463.5	7.90	200.5	0.95	336	1.45
CGLP	234.375	2.00	468.75	7.60	200.25	0.95	331	1.45
CHHS	233.375	2.13	466.75	7.60	200.25	0.95	333	1.45
CMZZ	230.125	1.56	460.25	6.80	200.75	0.95	339	1.45
DBBB	235.0	1.75	470.5	7.00	200.0	0.95	330	1.45
DDPD	233.75	1.70	467.5	7.00	200.5	0.95	332	1.45
DMZZ	230.125	1.50	460.25	6.50	200.75	0.95	339	1.45
FBBB	235.0	1.75	470.0	6.90	200.0	0.95	330	1.45
FDSV	232.125	2.10	464.25	7.60	200.75	0.95	335	1.45
YFTK	231.25	2.30	462.5	7.90	200.5	0.95	337	1.45
SJZL	230.75	1.87	461.5	7.40	200.5	0.95	338	1.45
FLBB	235.0	1.60	470.0	7.00	200.0	0.95	330	1.45
FLDG	233.0	2.07	466.0	7.70	200.0	0.95	334	1.45
FLZZ	230.125	1.83	460.25	7.30	200.75	0.95	339	1.45
FMBB	235.0	1.70	470.0	7.10	200.0	0.95	330	1.45
FMZZ	230.125	1.43	460.25	6.80	200.75	0.95	339	1.45
GBBB	235.0	1.73	470.0	7.20	200.0	0.95	330	1.45
GCZZ	230.125	1.93	460.25	7.50	200.75	0.95	339	1.45

Figure 7-13. Discriminator Subassembly Test Data

7–46. Discriminator Subassembly Tests. Operation of the discriminator subassembly can be checked as follows:

a. Set the frequency selector switches on the radio set control to the positions listed in figure 7–13. (Refer to note following paragraph 2–10.)

b. Connect frequency meter to indicated test points for each of the listed positions. Measured frequencies for each test point should be as listed.

c. Remove frequency meter and connect vtvm to indicated test points for voltage measurements. Do not make voltage measurements with frequency meter connected or readings will be in error.

7–47. The following tests can be made at any setting of the "CHANNEL" select switches on the radio set control as the measurements should always be about the same (after minimum 15-minute warmup).

a. Connect frequency meter to "J3403". A frequency of 1 megacycle ± 1 cycle should be obtained.

b. Move frequency meter probe to "J3404". A frequency of 100 kc ± 1 cycle should be obtained.

c. Move frequency meter probe to "J3409". A frequency of 50 kc ± 1 cycle should be obtained.

d. Move frequency meter probe to "J3410". A frequency of 10 kc ± 1 cycle should be obtained.

e. Move frequency meter probe to "J3411". A frequency of 5 kc ± 1 cycle should be obtained.

f. Connect VTVM probe to "J3405". A reading of +2.95 volts dc for pin 7 of V-3405 in lock position should be obtained. The equipment is to be tuned to 2.0 MHz and not keyed during this test.

g. Connect vtvm probe to "J3412". A reading of +105 volts dc should be obtained while channeling a new frequency. Upon completion of the channeling cycle a reading of +88 volts dc should be obtained.

h. Connect vtvm probe to "J3413". A reading between 5.0 and 8.0 volts dc should be obtained.

i. Connect vtvm probe to "J3403, J3404, J3409, J3410", and "J3411" in succession while noting the meter readings. The voltages measured should be in accordance with those listed in figure 7–14.

Test Point	Measured Volt (rms)
J3403	7.0—10.0
J3404	35.0
J3409	11.0
J3410	55.0
J3411	8.0

Figure 7–14. Discriminator Test Point Voltages

7–48. CMO Tracking Coverage Test. The range of frequencies covered by the variable capacitor in the cmo for each setting of switch S3305B can be checked as follows:

a. Disconnect coaxial line at "J3503" on the reference oscillator subassembly.

b. Connect Frequency Meter AN/USM–26 to pin 15 of P3302/J302 (test point L). A frequency reading (depending upon radio set control "CHANNEL" select switch settings) should be obtained.

c. Connect a clip lead to "J3412".

d. Set "CHANNEL" select switch on the radio set control to position "C". When the rotor plates of the variable capacitor (C33021) are approximately 45° less than half mesh, connect the clip lead to ground to stop the motor. A frequency reading no higher than 1850 kc should be obtained.

e. Disconnect the clip lead from ground and when the variable capacitor plates reach minimum capacitance (plates unmeshed) reconnect the clip lead to ground. A frequency reading no less than 2455 kc should be obtained.

f. Repeat steps b through e for each of the megacycle "CHANNEL" select switch positions listed in figure 7–15. Frequency ranges for minimum and maximum capacitance settings of the variable capacitor should be as listed in figure 7–15.

MC Switch Settings	Minimum Capacitance (Minimum Frequency in KC)	Maximum Capacitance (Maximum Frequency in KC)
B	1945	1710
D	2970	2330
F	3480	2820
G	3600	3350

Figure 7–15. Tracking Coverage Test Frequencies

7–49. CHECK-OUT OR ANALYSIS. A malfunction in the channelizer subassembly will result in little or no output from the cmo, or improper frequency selection. Frequency instability may be caused by a defect in the temperature controlled oven located in the dual crystal oscillator subassembly, or where the units fine frequency selection is incorrect, trouble may be traced to the bias voltage string or varicap diodes located in the dual crystal oscillator subassembly, or the three locked oscillator stages, and/or relay control stage located in the discriminator subassembly. As the resultant output of the three locked oscillator stages is used to drive the 5-kc and 50-kc harmonic amplifier stages located in the channelizer subassembly, the latter circuitry should also be checked. In any case, when trouble is experienced in the basic frequency selection circuits, always check the channelizer, dual crystal oscillator, discriminator, and reference oscillator subassemblies in accordance with their minimum performance standards outlined in paragraphs 7–42, 7–45, 7–46, and 7–107 respectively. Where the trouble is isolated to any one of these subassemblies, check the malfunctioning subassembly in accordance with figures 7–16 and 7–17 for the channelizer and discriminator, figure 7–30 for the dual crystal oscillator, and figure 7–39 for the reference oscillator. If all four of

these units are functioning normally, then the fault may be traceable to the tuner and power amplifier subassemblies (refer to paragraphs 7-115 and 7-160, respectively).

7-50. Most of the signal level test points for checking of the dual crystal oscillator, discriminator, and channelizer subassemblies are located on the discriminator subassembly. Therefore, it is necessary when checking, to refer to all three schematic diagrams in order to understand the circuits being checked. It is also necessary for the technician to memorize the number series of the symbol designations for the various subassemblies in order to know which unit contains the detail part or test point mentioned in the chart. Arbitrarily selected test points are assigned to each subassembly. The channelizer subassembly is assigned the A1 and up series, the B1 and up series is assigned to the dual crystal oscillator subassembly, the C1 and up series to the discriminator subassembly, and the D1 and up series to the reference oscillator subassembly. All tests are to be performed in the bench test setup shown in figure 2-2, with the dual crystal oscillator and discriminator subassemblies plugged into the channelizer subassembly and the latter removed from the main chassis. Two of the 20-pin plug extension cables (fabricated as described in paragraph 3-7) are to be used to interconnect the channelizer and main chassis subassemblies. When checking voltages in either one of the plug-in subassemblies (dual crystal oscillator or discriminator) extension cables are to be used to interconnect the respective subassembly with the channelizer subassembly.

7-51. Removal and replacement procedures are to be performed as outlined in paragraph 7-52, and in those cases where realinement is required, paragraph 7-56 describes all alinement procedures. Figures 7-20 through 7-22, and figure 7-35 shows the location of the various test points and figures 7-25, 7-32, and 7-37 are the schematic diagrams.

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
1	None	None	Function control on Radio Set Control CPC-1 to "AME" position. Select "BBBB" "CHANNEL" switch setting to keep motor operating	Motor should run for a period of 50 to 105 seconds and then stop. (See note following paragraph 2-10.)	1a. If motor runs in excess of 105 seconds, S3306 is defective. 1b. Replace S3306 and repeat test. If motor does not run, check K3301, K3305 and motor B3301.
2	J3401	Frequency Meter AN/USM-26, VTVM TS-375/U	Set "CHANNEL" select switches on Radio Set Control CPC-1 to "BKBB" positions.	235.0 kc ± 1 cps at 1.5 volts rms. Proceed to step 4.	2a. Check T3401 and V3306. 2b. Check J3301/P3401 receptacle contacts. Proceed to step 3.
3	A8	Same as step 2.	Same as steps 1 and 2. Connect meters to pin 4 of V3306.	35.0 kc ± 1 cps at 0.85 volts rms. Proceed to step 4.	3a. Check V3305 and associated voltages as shown in figure 7-18. 3b. Make certain contacts on switches are closing properly. Proceed to step 4.
4	J3411	Same as step 2.	Same as steps 1 and 2.	5 kc ± 1 cps at 8 volts rms. Proceed to step 5.	4a. Check V3409 and all associated voltages as shown in figure 7-34. 4b. Check all detail parts. Proceed to step 5.
5	J3410	Same as step 2.	Same as steps 1 and 2.	10 kc ± 1 cps at 55 volts rms. Proceed to step 6.	5a. Check V3408 and associated voltages as shown in figure 7-34. 5b. Check all detail parts. Proceed to step 6.
6	J3409	Same as step 2.	Same as steps 1 and 2.	50 kc ± 1 cps at 11 volts rms. Proceed to step 7.	6a. Check V3407 and associated voltages as shown in figure 7-34. 6b. Check all detail parts. Proceed to step 7.

Figure 7-16. Channelizer Subassembly Electronics Circuits Trouble Analysis Chart (Sheet 1 of 3)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
7	J3503	Same as step 2.	Same as steps 1 and 2.	100 kc ± 1 cps at 9.5 volts rms. Proceed to step 8.	7a. Check reference oscillator subassembly as outlined in paragraph 7–105. Proceed to step 8.
8	A9	Same as step 2.	Same as steps 1 and 2.	200.0 kc ± 1 cps at 0.44 volts rms. Proceed to step 9.	8a. Check V3304 and associated voltages as shown in figure 7–18. 8b. Check T3302 and switch contacts associated with V3304. Proceed to step 9.
9	A7	Same as step 2.	Same as steps 1 and 2.	550 kc ± 1 cps at 0.75 volts rms. Proceed to step 10.	9a. Check V3303 and associated voltages as shown in figure 7–18. 9b. Check all detail parts and switches associated with V3303. Proceed to step 10.
10	J3409	Same as step 2.	Same as steps 1 and 2.	50 kc ± 1 cps at 11 volts rms. Proceed to step 13.	10a. Same as step 6. Proceed to step 11.
11	A6	Same as step 2.	Same as steps 1 and 2.	750 kc ± 1 cps at 0.3 volts rms. Proceed to step 12.	11a. Check V3302 and associated voltages as shown in figure 7–18. 11b. Check T3301 and all associated circuit parts. Proceed to step 12.
12	A5	Same as step 2.	Same as steps 1 and 2.	1750 kc ± 3.2 cps at 0.2 to 0.4 volts rms. Proceed to step 13.	12a. Check V3307 and associated voltages as shown in figure 7–18. 12b. Check all cmo circuit parts and switches. Proceed to step 13.
13	J3413	VTVM TS–375/U	Same as steps 1 and 2.	5.0 to 18 volts dc. Proceed to step 14.	13a. Check V3405B and associated voltages as shown in figure 7–34. 13b. Check CR3309 and CR3310 and all associated detail parts. 13c. Check +9-volt bias source. Proceed to step 14.
14	J3405	Same as step 13.	Same as steps 1 and 2.	Approximately 4.5 volts dc. Proceed to step 15.	14a. Check CR3401, CR3402, CR3403, CR3404, and C3416. 14b. Check V3405A and all associated parts and voltages. Proceed to step 15.
15	J3406	Frequency Meter AN/USM–26 and Oscilloscope TER 545	Same as steps 1 and 2.	15 to 20 volts peak-to-peak at 100 kc ± 1 cps. Proceed to step 16.	15a. Check reference oscillator subassembly as outlined in paragraph 7–105. Proceed to step 16.

Figure 7–16. Channelizer Subassembly Electronics Circuits Trouble Analysis Chart (Sheet 2 of 3)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
16	J3404	Same as step 2.	Same as steps 1 and 2.	29 volts rms at 100 kc ± 1 cps. Proceed to step 17.	16a. Check V3403 and all associated parts and voltages as shown in figure 7-34. 16b. Check V3404 voltages and all associated detail parts. Proceed to step 17.
17	J3403	Same as step 2.	Same as steps 1 and 2.	1 mc ± 1 cps at 7.0 to 10 volts rms. Proceed to step 18.	17a. Check V3402 voltages and all associated detail parts. Proceed to step 18.
18	J3402	Same as step 2.	Same as steps 1 and 2.	470 kc ± 1 cps at 5.0 to 8.0 volts rms. Proceed to step 19.	18a. Check V3401 voltages and all associated detail parts. Proceed to step 19.
19	C1	Same as step 2.	Same as steps 1 and 2.	530 kc ± 5 cps at approximately 1.5 volts rms. Proceed to step 20.	19a. Check V3406 voltages and all associated detail parts. Proceed to step 20.
20	J3407	Same as step 2.	Same as steps 1 and 2.	200.0 kc ± 3 cps at 0.95 volts rms. Proceed to step 21.	20a. Check mating receptacles and wiring between discriminator, channelizer, and dual crystal oscillator subassemblies. 20b. Check dual crystal oscillator subassembly. Proceed to step 21.
21	J3408	Same as step 2.	Same as steps 1 and 2.	330 kc ± 3 cps at 1.45 volts rms. Proceed to step 22.	21a. Same as step 20a. Proceed to step 22.
22	J3401	Same as step 2.	Same as steps 1 and 2.	Same as step 2. Proceed to step 23.	22a. Same as step 2. Proceed to step 23.
23	A4	Same as step 2.	Same as steps 1 and 2.	2500 kc ± 3 cps at 0.7 volts rms. Proceed to step 24.	23a. Check V3301 voltages and all associated detail parts. 23b. Check all switches for positive contact closure. Proceed to step 24.
24	A3	Same as step 2.	Same as steps 1 and 2.	500 kc ± 1 cps at 3.0 to 5.0 volts rms.	24a. Check for continuity of circuits between V3301-1 and J3506 located on reference oscillator subassembly. 24b. Check reference oscillator subassembly as outlined in paragraph 7-105.

Figure 7-16. Channelizer Subassembly Electronics Circuits Trouble Analysis Chart (Sheet 3 of 3)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
1	J3413	VTVM TS-375/U	Function control on Radio Set Control CPC-1 set to "AME" position and "CHANNEL" select switches set to "BKBB".	5.0 to 8 volts dc. Proceed to step 4.	1a. Check discriminator subassembly circuits as outlined in steps 13 through 22 of figure 7-16.
2	J3412	VTVM TS-375/U	Same as step 1.	+85 to +108 volts dc.	2a. Check V3410 voltages as shown in figure 7-34 and associated detail parts. Proceed to step 3.
3	A2	VTVM TS-375/U	Same as step 1.	105 to 110 volts dc.	3a. Check V3309 and all associated voltages and detail parts as shown on figure 7-18. 3b. Check relay K3302 coil for open or short circuit. Proceed to step 4.
4	None	None	Same as step 1 except select "BBBB" "CHANNEL" to keep motor running.	Motor should run for a period of 50 to 105 seconds. After motor has stopped, follow instructions in note following paragraph 2-10.	4a. If motor runs in excess of 105 seconds S3306 is defective. 4b. Replace S3306 and repeat test. 4c. If motor fails to run, check operation of relays K3301 and K3302. 4d. Replace motor. Proceed to step 5.
5	Visual	None	Set megacycle "CHANNEL" switch on radio set control to "G" position. This test checks the operation of the megacycle tuning control circuits of the channelizer and radio set control. Refer to note following paragraph 2-10 before proceeding.	When control switching is satisfied, the clutch solenoid will be deenergized, drop into a detent in the clutch and the clutch shaft will cease to rotate, even though the motor continues to operate. Proceed to step 6.	5a. Check operation of L3301, K3303, K3305, S3305A, S3301B (front), S3301A (front) and all interconnecting wiring. 5b. Replace radio set control. If this clears fault check as described in Section VIII. Proceed to step 6.
6	Visual	None	Repeat step 5 for positions "H, M, N, T, V," and "Z" of the megacycle "CHANNEL" select switch.	Same as step 5.	Same as previous step.
7	Visual	None	Set "CHANNEL" select switches on radio set control to "BBBB" position.	Same as step 5. Note that selected contact is one position ccw from the long contact on switch wafers S3301B (rear) and two switch positions ccw from the long contact on switch wafers S3302D (rear) and S3303D (rear). Proceed to step 8.	7a. Check mechanical coupling between motor and all drive shafts. 7b. Check for binding in drive shafts. 7c. Replace radio set control. 7d. Check operation of L3301 through L3304 by observing operation of clutches during channeling cycle.

Figure 7-17. Channelizer Subassembly Electro-Mechanical Trouble Analysis Chart (Sheet 1 of 2)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
					7e. Check operation of all relays. Proceed to step 12.
8	J3407	Frequency Meter AN/USM-26	Same as step 7.	200 kc ± 3 cps Proceed to step 9.	8a. Check operation of dual crystal oscillator subassembly as outlined in paragraph 7-45. Proceed to step 9.
9	J3408	Same as step 8.	Same as step 7.	330 kc ± 3 cps. Proceed to step 10.	9a. Same as step 8. Proceed to step 10.
10	J3408	Same as step 8.	Set "CHANNEL" select switches to "GMZZ" position.	339 kc ± 3 cps. Proceed to step 11.	10a. Same as step 8. Proceed to step 11.
11	J3407	Same as step 8.	Same as step 10.	200.75 kc ± 3 cps. Proceed to step 12.	11a. Same as step 8. Proceed to step 12.
12	Visual A1	None Multimeter TS-352/U	Same as step 10.	Selected contacts on rear wafers of S3301B and S3305B should be 5 positions ccw from the long contact, and 1 position cw from long contact on rear wafers of switches S3302D and S3303D. If all foregoing tests are normal, check electronic circuits as described in figure 7-16.	12a. Same as step 7. 12b. Check operation of K3304. 12c. Check resistance bridge R3320. Individual resistances should be as shown in figure 7-25. Total resistance should be 304 ohms (with radio set control disconnected).

Figure 7-17. Channelizer Subassembly Electro-Mechanical Trouble Analysis Chart (Sheet 2 of 2)

7-52. REMOVAL AND REPLACEMENT. The channelizer subassembly can only be removed from the main chassis after removal of the discriminator subassembly. The assembled channelizer subassembly is shown in figure 7-19 and with the tubes, dual crystal oscillator, and discriminator subassemblies removed in figure 7-20. Removal procedures are as follows:

a. Remove all power from the equipment.

b. Loosen the three redheaded captive screws securing the discriminator subassembly in place.

c. Remove the discriminator from the channelizer by pulling the unit straight up and out of its receptacle.

d. Loosen the three redheaded captive screws securing the channelizer subassembly to the main chassis.

e. Grasp the handles at the top of the channelizer and pull the subassembly straight up and out of the chassis mounted receptacles.

7-53. Access to the tube socket pins and associated wiring can be attained by removing the five securing screws from the end cover of the channelizer subassembly and removing the cover. This cover must also be removed when it is desirable to remove or replace the dual crystal oscillator subassembly. Proceed as follows to remove the dual crystal oscillator subassembly:

a. Remove the channelizer subassembly as outlined in paragraph 7-52.

b. Remove plug P3601 from the receptacle "J3302".

c. Remove the end cover of the channelizer.

d. Loosen the three screws (located near the motor drive) securing the dual crystal oscillator subassembly to the channelizer chassis. These screws can be located after removal of the end cover of the channelizer. Support the dual crystal oscillator subassembly while loosening the screws to prevent the unit from dropping and causing damage.

e. Carefully pull the dual crystal oscillator subassembly from place (after removing J3302 from its receptacle by pulling straight out. Use care in removing so the switch setting in the unit remains in proper relation to the switch shaft mounted on the channelizer chassis.

7–54. Access to the wiring and tube socket pins of the discriminator can be attained by removing the seven screws securing the side cover in place and removing the cover. When it is desired to check the wiring on the other side of the subassembly, the discriminator must be removed from the channelizer chassis as described in paragraph 7–52. Access to the wiring can then be attained by removing the seven screws securing the side cover in place.

7–55. When it is desired to check a crystal suspected of being defective, the crystal oven must be removed from the dual crystal oscillator subassembly. This can be accomplished with the subassembly removed from or in place on the channelizer chassis. Proceed as follows:

a. Remove the two screws securing the oven to the rear of the unit.

b. Remove the oven from the unit. Use care while removing the oven as it is a tight fit and if pulled off too forcibly, may cause damage to the wires connecting the self-contained heater to the main subassembly.

c. When removed, place the oven near the subassembly using care not to place a strain on the heater interconnecting wires.

7–56. The channelizer subassembly can be replaced and reassembled by reversing the procedures outlined in paragraphs 7–52 and 7–53. Reassembly and replacement of the discriminator can be accomplished by reversing the procedures outlined in paragraphs 7–52 and 7–54.

7–57. ALINEMENT AND ADJUSTMENT. After repair or replacement of any parts in the cmo, the tracking coverage test of paragraph 7–48 should be performed. If the band coverage is less than indicated in the procedure and figure 7–15, the inductance of L3313 must be increased and the capacitance of C3301O should be decreased. If the band coverage is greater, decrease the inductance of L3313 and increase the capacitance of C3301O. Adjustment of C3301O and L3313 can be accomplished with the subassembly removed from the main chassis, and the side cover removed, as shown in figure 7–21. Figure 7–22 shows the test point and alinement locations.

7–58. Alinement of L3307. Proceed as follows:

a. Disconnect coaxial lead from "J3503" on the reference oscillator subassembly.

b. Clip a 0.1 uf capacitor from end of C33027 of pin 4 of V3302 to ground.

c. Clip a 0.1 uf capacitor from junction of L3308 and C3345 to ground.

d. Clip a 0.1 uf capacitor from junction of L3311 and C3388 to ground.

e. Connect Frequency Meter AN/USM–26 to signal generator output and connect signal generator output through a 0.1 uf capacitor to pin 1 of V3302.

f. Set signal generator to an unmodulated output frequency of 1075 kc.

Note

When setting the signal generator to the frequencies indicated in this procedure, always monitor the output with the frequency meter. This is necessary as the output frequency must be exact. Also, the output level must be maintained at a value to give approximately 0.02 volt rms as measured by the vtvm connected to pin 5 of V3304.

g. Set the hundreds "CHANNEL" select switch (second from left) on the radio set control to the "B" position. When the hundreds clutch shaft stops rotating. Connect a clip lead between "J3412" and ground to stop the motor.

h. Make certain the output level of the signal generator is sufficient to give the level indicated in the note following step f.

i. Adjust the slug of L3307 for maximum indication on the vtvm.

7–59. Alinement of L3310. Proceed as follows:

a. Disconnect coaxial lead from "J3503" on the reference oscillator subassembly.

b. Clip a 0.1 uf capacitor from junction of L3308 and C3345 to ground.

c. Clip a 0.1 uf capacitor from the junction of L3311 and C3388 to ground.

d. Connect the signal generator through a 0.1 uf capacitor to pin 1 of V3304.

e. Set the signal generator output to 197.5 kc. Use the frequency meter to obtain exact frequency setting.

f. Set the tens "CHANNEL" select switch (third from left) on the radio set control to position "B". When the tens clutch shaft stops rotating, connect the clip lead from "J3412" to ground to stop the motor.

g. Connect the vtvm probe to the junction of C3376 and C3377. Maintain signal generator output to give 0.2 to 0.4 volt rms level on vtvm.

h. Adjust the tuning slug of L3310 for maximum indication on the vtvm.

7–60. Alinement of L3311 and L3312. Proceed as follows:

a. Disconnect coaxial lead from "J3503" on the reference oscillator subassembly.

b. Clip a 0.1 uf capacitor from the junction of R3321 and CR3305 to ground.

c. Clip a 0.1 uf capacitor from the junction of R3333 and CR3307 to ground.

d. Connect the signal generator through a 0.1 uf capacitor to pin 1 of V3305.

e. Set signal generator output to 80 kc. Use the frequency meter to obtain exact frequency.

f. Set the tens "CHANNEL" selector switch (third from left) on the radio set control to the "M" position. When the tens clutch shaft stops rotating, connect clip lead from "J3412" and ground to stop the motor.

g. Connect the vtvm probe to pin 4 of V3306. Maintain signal generator output to give level of 0.4 to 0.5 volt rms on vtvm.

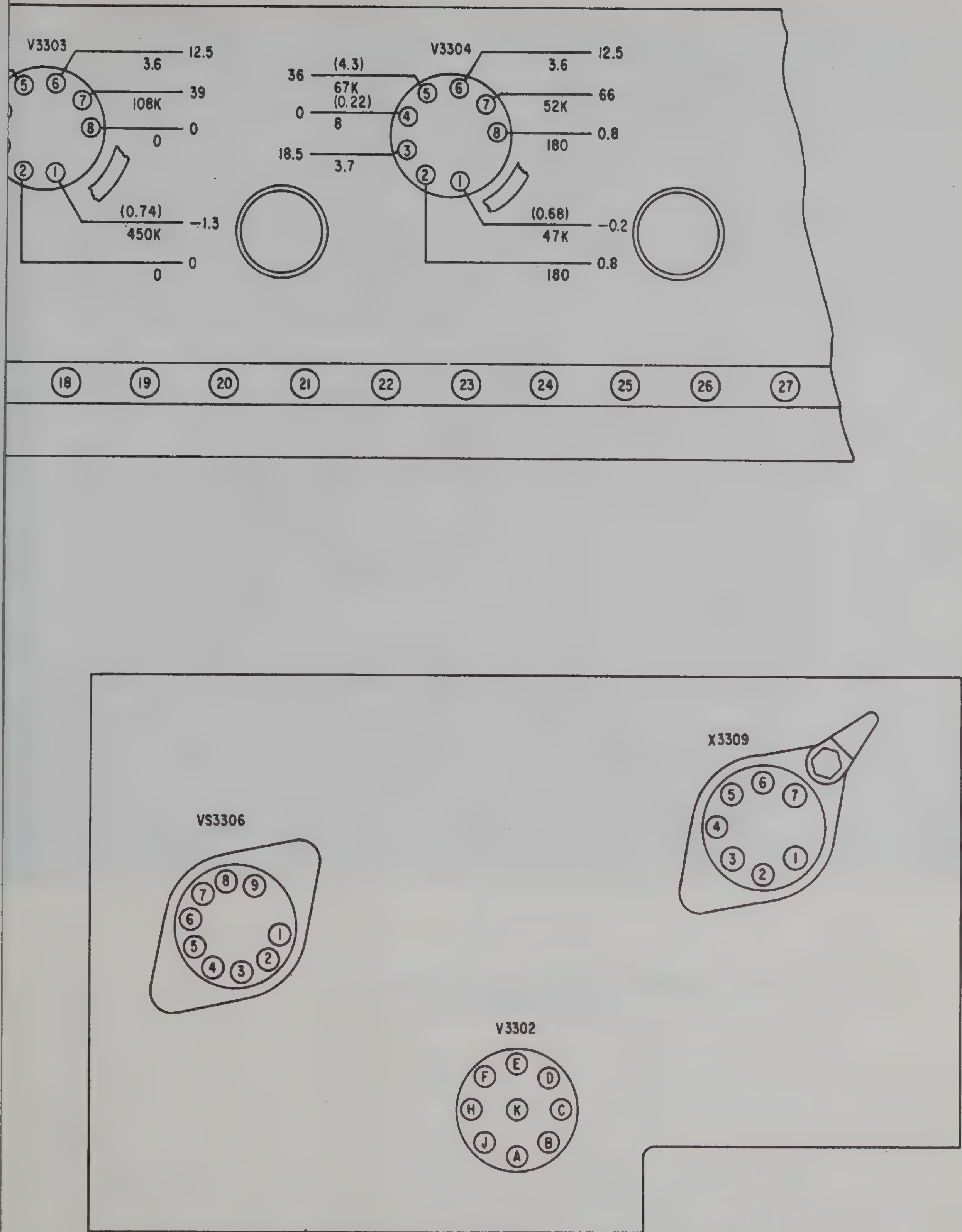


Figure 7–18. Channelizer Subassembly Tube Voltage and Resistance Diagram

7–54. Access to the wiring and tube socket pins of the discriminator can be attained by removing the seven screws securing the side cover in place and removing the cover. When it is desired to check the wiring on the other side of the subassembly, the discriminator must be removed from the channelizer chassis as described in paragraph 7–52. Access to the wiring can then be attained by removing the seven screws securing the side cover in place.

7–55. When it is desired to check a crystal suspected of being defective, the crystal oven must be removed from the dual crystal oscillator subassembly. This can be accomplished with the subassembly removed from or in place on the channelizer chassis. Proceed as follows:

a. Remove the two screws securing the oven to the rear of the unit.

b. Remove the oven from the unit. Use care while removing the oven as it is a tight fit and if pulled off too forcibly, may cause damage to the wires connecting the self-contained heater to the main subassembly.

c. When removed, place the oven near the subassembly using care not to place a strain on the heater interconnecting wires.

7–56. The channelizer subassembly can be replaced and reassembled by reversing the procedures outlined in paragraphs 7–52 and 7–53. Reassembly and replacement of the discriminator can be accomplished by reversing the procedures outlined in paragraphs 7–52 and 7–54.

7–57. ALINEMENT AND ADJUSTMENT. After repair or replacement of any parts in the cmo, the tracking coverage test of paragraph 7–48 should be performed. If the band coverage is less than indicated in the procedure and figure 7–15, the inductance of L3313 must be increased and the capacitance of C3301O should be decreased. If the band coverage is greater, decrease the inductance of L3313 and increase the capacitance of C3301O. Adjustment of C3301O and L3313 can be accomplished with the subassembly removed from the main chassis, and the side cover removed, as shown in figure 7–21. Figure 7–22 shows the test point and alinement locations.

7–58. Alinement of L3307. Proceed as follows:

a. Disconnect coaxial lead from "J3503" on the reference oscillator subassembly.

b. Clip a 0.1 uf capacitor from end of C33027 of pin 4 of V3302 to ground.

c. Clip a 0.1 uf capacitor from junction of L3308 and C3345 to ground.

d. Clip a 0.1 uf capacitor from junction of L3311 and C3388 to ground.

e. Connect Frequency Meter AN/USM–26 to signal generator output and connect signal generator output through a 0.1 uf capacitor to pin 1 of V3302.

f. Set signal generator to an unmodulated output frequency of 1075 kc.

Note

When setting the signal generator to the frequencies indicated in this procedure, always monitor the output with the frequency meter. This is necessary as the output frequency must be exact. Also, the output level must be maintained at a value to give approximately 0.02 volt rms as measured by the vtvm connected to pin 5 of V3304.

g. Set the hundreds "CHANNEL" select switch (second from left) on the radio set control to the "B" position. When the hundreds clutch shaft stops rotating. Connect a clip lead between "J3412" and ground to stop the motor.

h. Make certain the output level of the signal generator is sufficient to give the level indicated in the note following step f.

i. Adjust the slug of L3307 for maximum indication on the vtvm.

7–59. Alinement of L3310. Proceed as follows:

a. Disconnect coaxial lead from "J3503" on the reference oscillator subassembly.

b. Clip a 0.1 uf capacitor from junction of L3308 and C3345 to ground.

c. Clip a 0.1 uf capacitor from the junction of L3311 and C3388 to ground.

d. Connect the signal generator through a 0.1 uf capacitor to pin 1 of V3304.

e. Set the signal generator output to 197.5 kc. Use the frequency meter to obtain exact frequency setting.

f. Set the tens "CHANNEL" select switch (third from left) on the radio set control to position "B". When the tens clutch shaft stops rotating, connect the clip lead from "J3412" to ground to stop the motor.

g. Connect the vtvm probe to the junction of C3376 and C3377. Maintain signal generator output to give 0.2 to 0.4 volt rms level on vtvm.

h. Adjust the tuning slug of L3310 for maximum indication on the vtvm.

7–60. Alinement of L3311 and L3312. Proceed as follows:

a. Disconnect coaxial lead from "J3503" on the reference oscillator subassembly.

b. Clip a 0.1 uf capacitor from the junction of R3321 and CR3305 to ground.

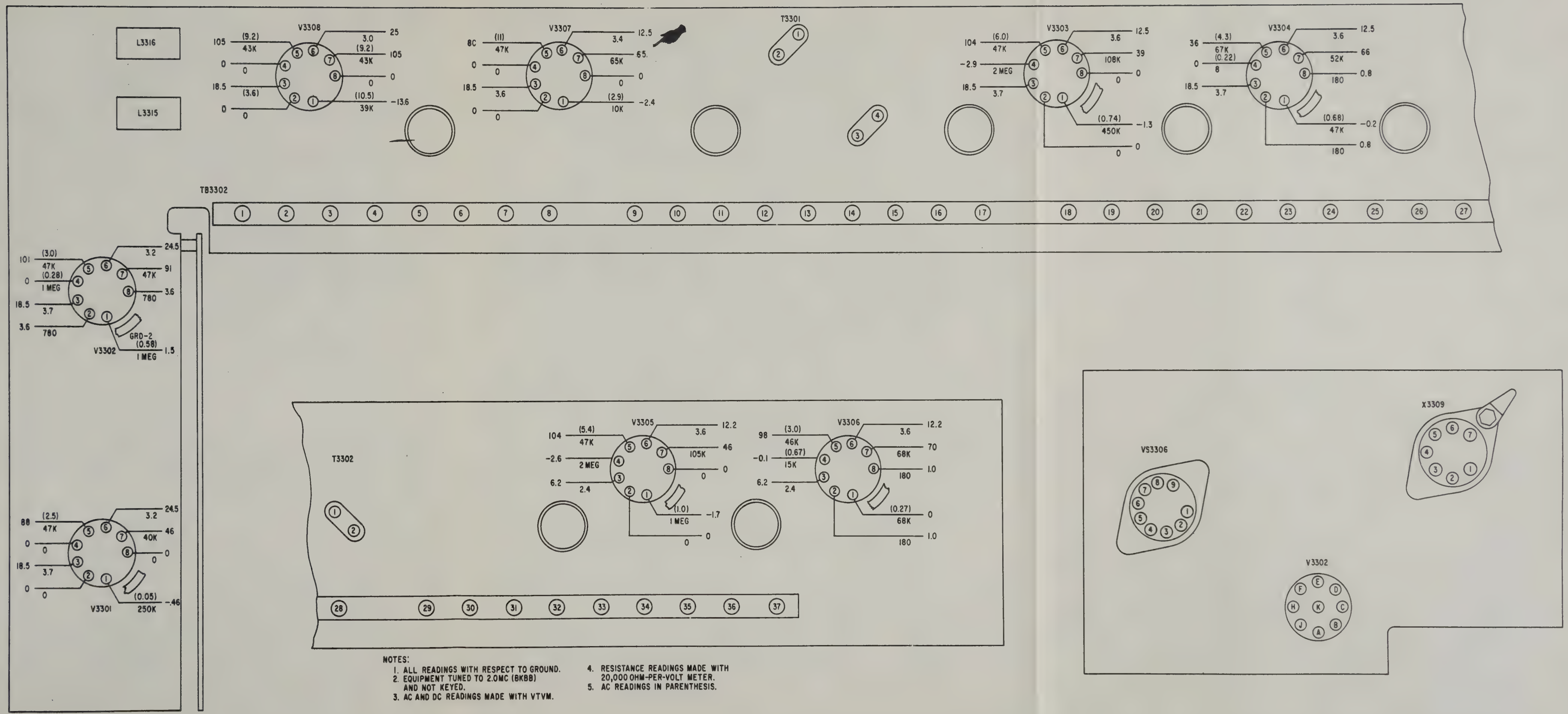
c. Clip a 0.1 uf capacitor from the junction of R3333 and CR3307 to ground.

d. Connect the signal generator through a 0.1 uf capacitor to pin 1 of V3305.

e. Set signal generator output to 80 kc. Use the frequency meter to obtain exact frequency.

f. Set the tens "CHANNEL" selector switch (third from left) on the radio set control to the "M" position. When the tens clutch shaft stops rotating, connect clip lead from "J3412" and ground to stop the motor.

g. Connect the vtvm probe to pin 4 of V3306. Maintain signal generator output to give level of 0.4 to 0.5 volt rms on vtvm.



NOTES:
1. ALL READINGS WITH RESPECT TO GROUND.
2. EQUIPMENT TUNED TO 2.0MC (BKBB) AND NOT KEYED.
3. AC AND DC READINGS MADE WITH VTVM.
4. RESISTANCE READINGS MADE WITH 20,000 OHM-PER-VOLT METER.
5. AC READINGS IN PARENTHESIS.

Figure 7-18. Channelizer Subassembly Tube Voltage and Resistance Diagram

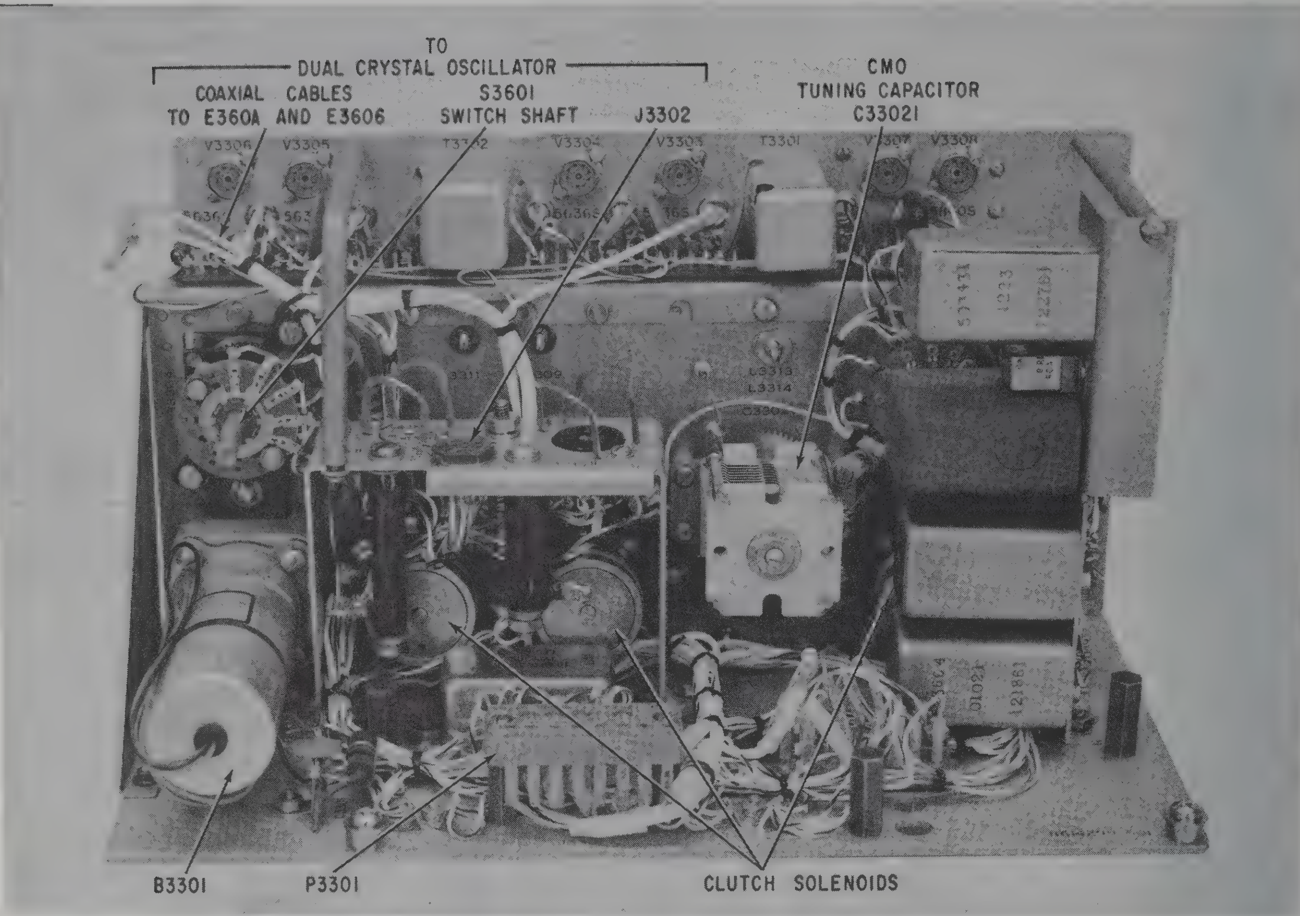


Figure 7–20. Channelizer Subassembly, Top View, With Tubes, Dual Crystal Oscillator, and Discriminator Subassemblies Removed

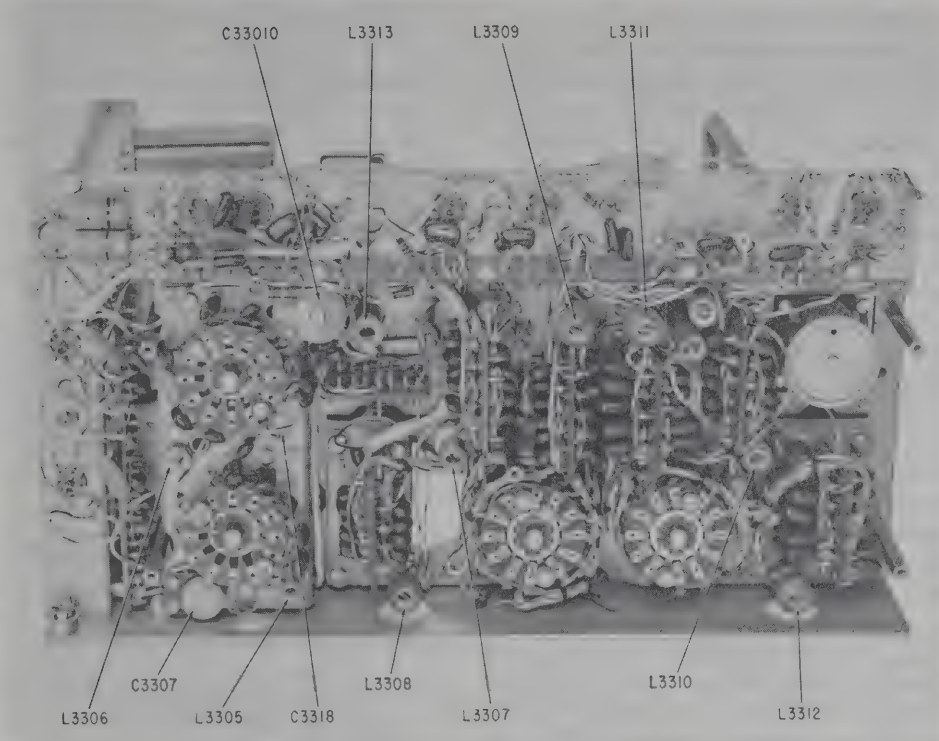


Figure 7-21. Channelizer Subassembly, End Cover Removed, Showing Alinement Points

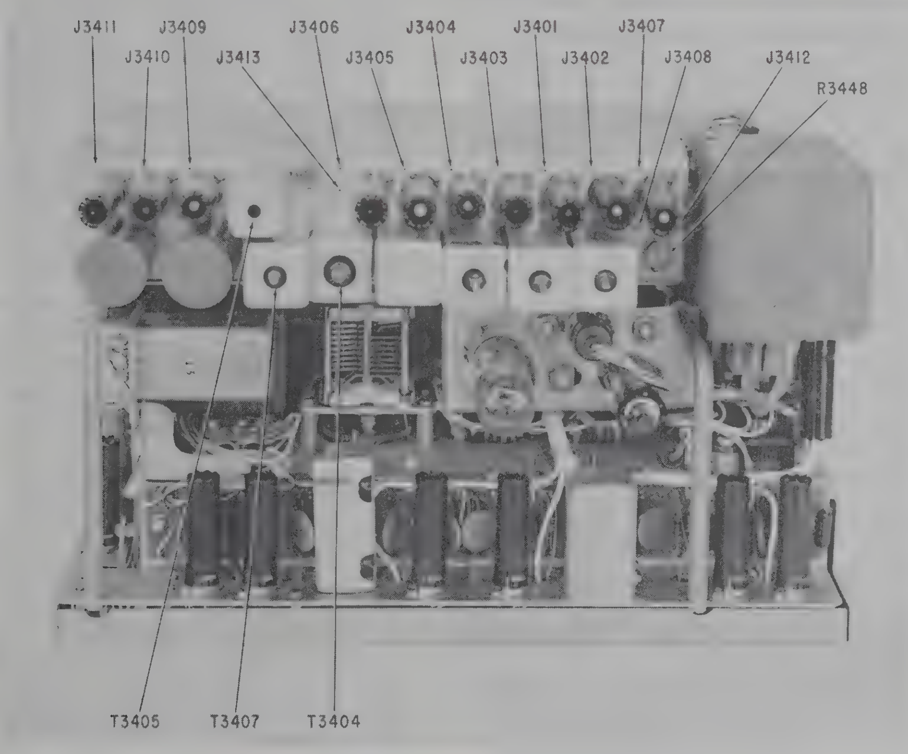


Figure 7-22. Channelizer Subassembly, Test and Alinement Points

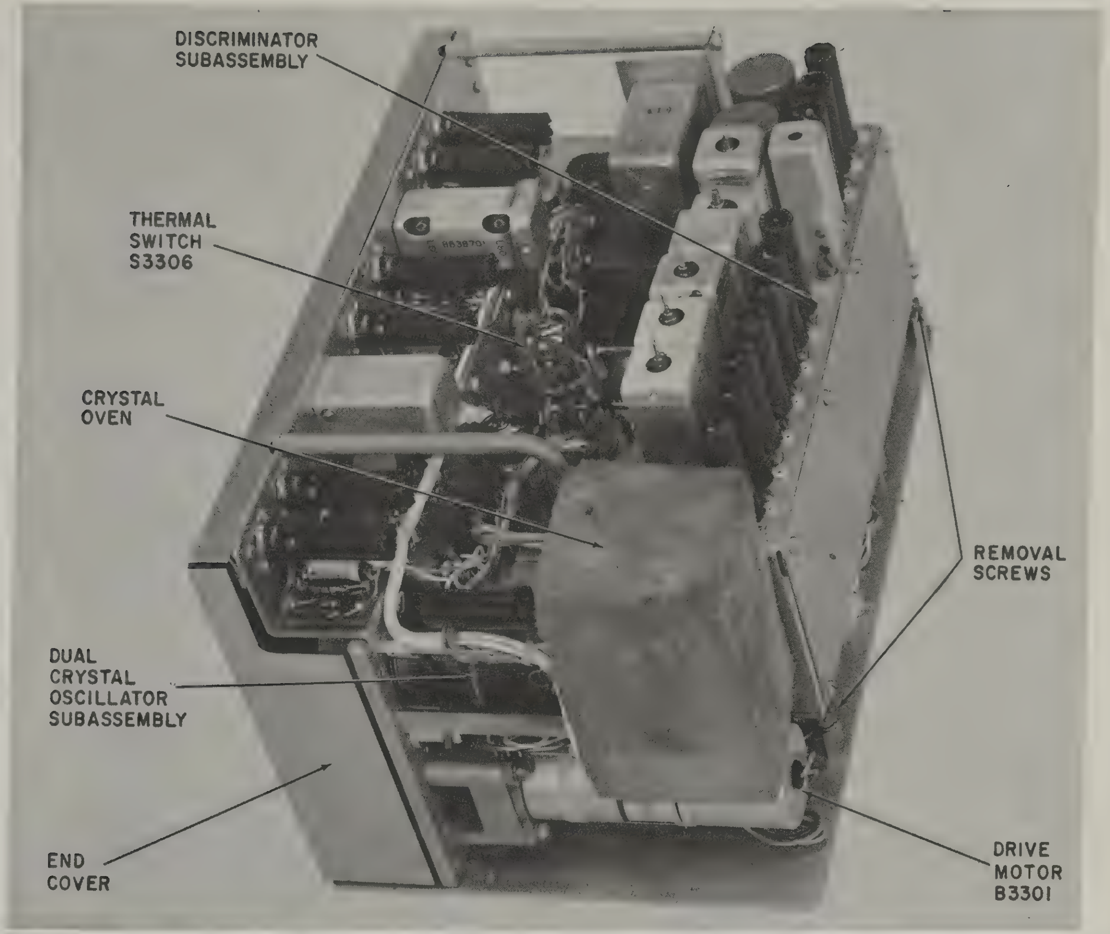


Figure 7–19. Channelizer Subassembly, Front Oblique View, Completely Assembled

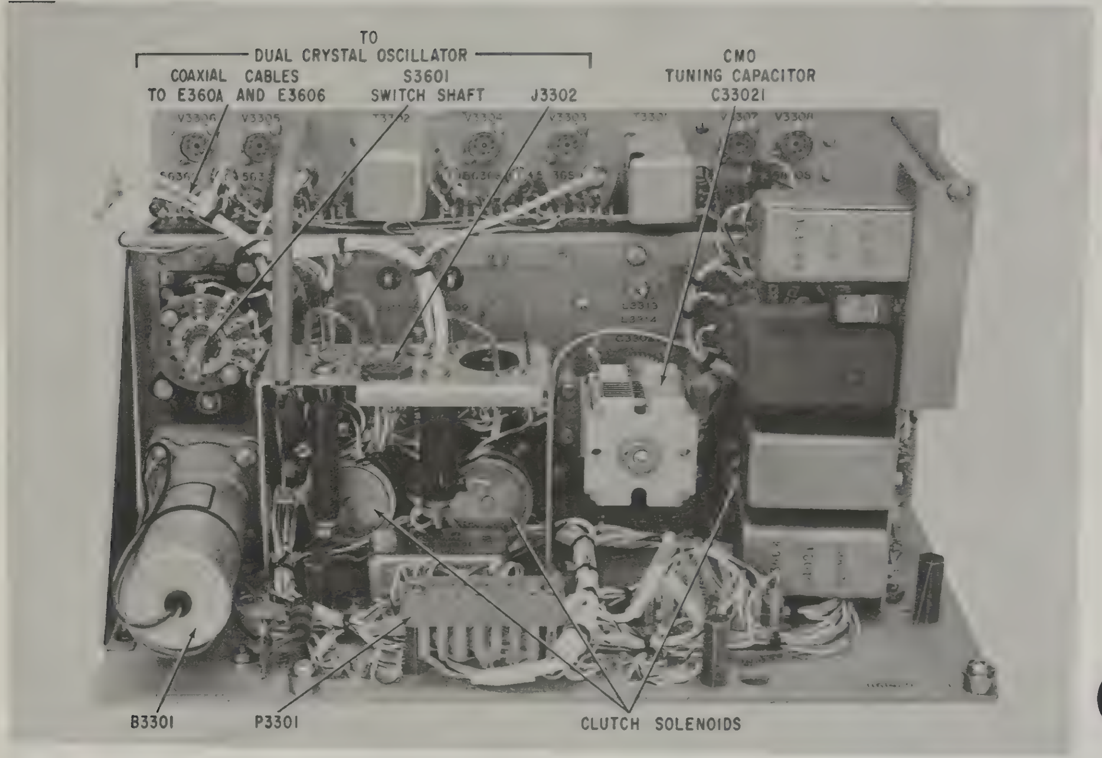


Figure 7–20. Channelizer Subassembly, Top View, With Tubes, Dual Crystal Oscillator, and Discriminator Subassemblies Removed

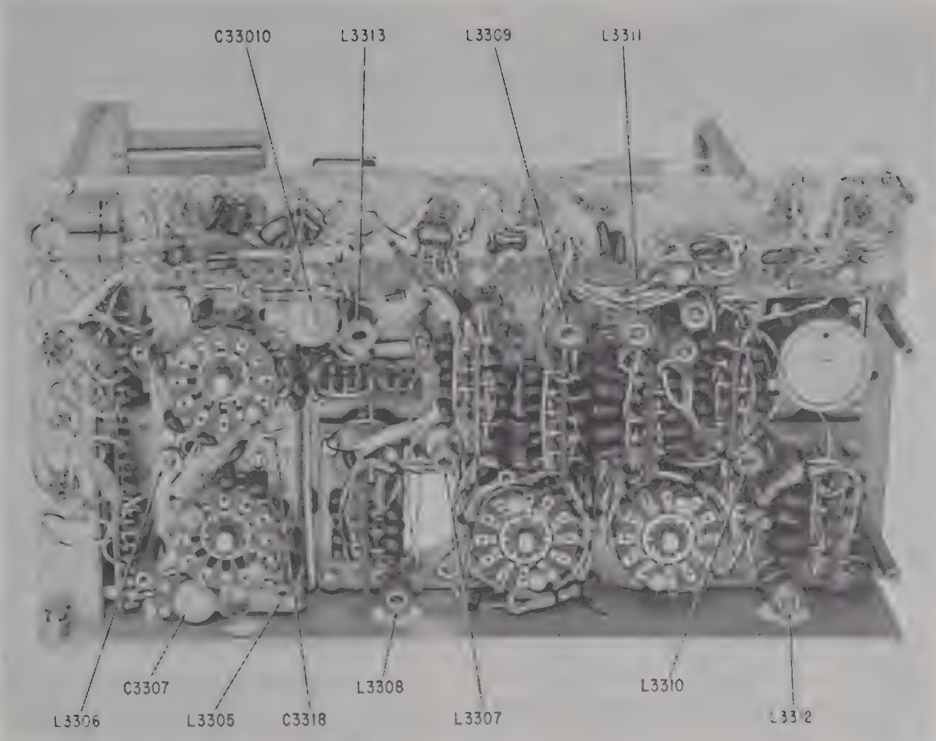


Figure 7-21. Channelizer Subassembly, End Cover Removed, Showing Alinement Points

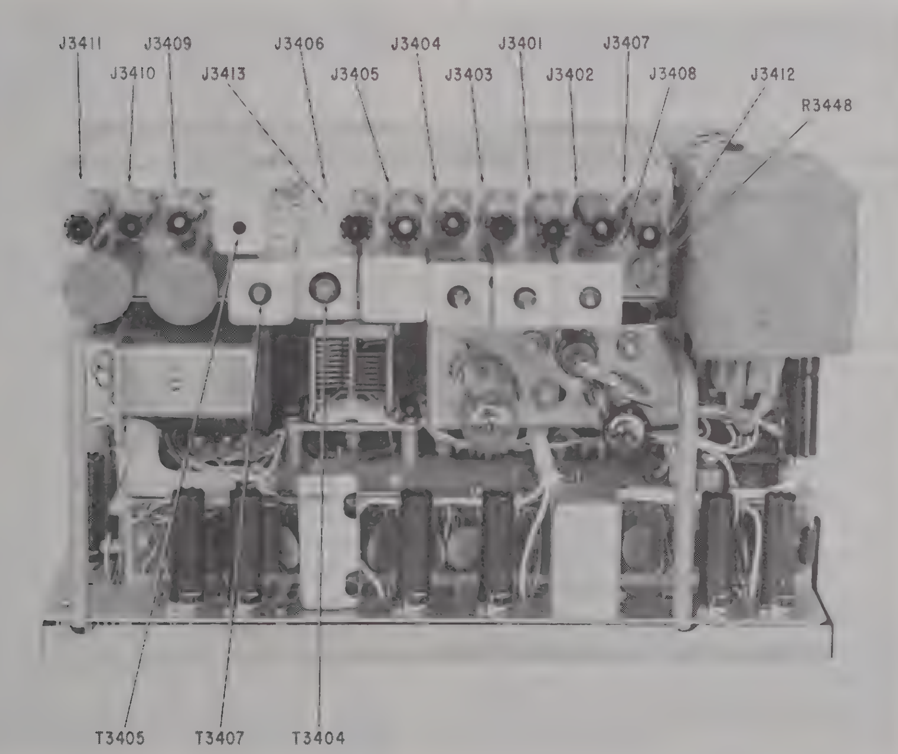


Figure 7-22. Channelizer Subassembly, Test and Alinement Points

h. Adjust the tuning slug on L3312 for maximum indication on the vtvm.

i. Disconnect signal generator from the tube pin.

j. Remove the 0.1 uf capacitor connected between the junction of R3333 and CR3307 and ground.

k. Carefully resonate L3311 for maximum indication on the vtvm.

l. Connect frequency meter to pin 4 of V3306. Frequency reading should be 80 kc.

m. Measure frequency and voltage for each tens "CHANNEL" select switch setting listed in figure 7–23. The frequency measurements are to be made with the frequency meter connected to pin 4 of V3306 and then the voltage measurements are to be made with the vtvm probe connected to the same point but with the frequency meter disconnected. All voltage measurements should be between 0.6 to 0.8 volt rms.

n. Connect vtvm probe to pin 4 of V3305. Voltage measurements between —2 and —4 volts dc should be obtained for each setting of the tens "CHANNEL" selector switch "M" through "B".

Tens Switch Setting	Frequency (KC)	Tens Switch Setting	Frequency (KC)
M	80	G	55
L	75	F	50
K	70	D	45
J	65	C	40
H	60	B	35

Figure 7–23. L3311 and L3312 Test Frequencies

7–61. Alinement of L3308 and L3309. Proceed as follows:

a. Disconnect the coaxial lead from "J3503" located on the reference oscillator subassembly.

b. Clip a 0.1 uf capacitor from the junction of R3321 and CR3305 to ground.

c. Connect the signal generator through a 0.1 uf capacitor to pin 1 of V3303.

d. Set signal generator output to 900 kc. Use the frequency meter to obtain exact frequency.

e. Set the hundreds "CHANNEL" select switch (second from left) on the radio set control to the "B" position. When the hundreds clutch shaft stops rotating, connect clip lead between "J3412" and ground to stop the motor.

f. Connect the vtvm probe to pin 1 of V3304. Maintain signal generator output to give level of 0.4 to 0.5 volt vms on vtvm.

g. Adjust the tuning slug on L3309 for maximum indication on the vtvm.

h. Disconnect the signal generator from the tube pin.

i. Remove the 0.1 uf capacitor connected between R3321 and ground.

j. Carefully adjust the tuning slug on L3308 for maximum indication on the vtvm.

k. Connect frequency meter to pin 1 of V3304. Frequency reading should be 900 kc. Repeat this step for each of the hundreds "CHANNEL" select switch settings "C" through "M". The frequencies measured should be in 50-kc increments between 850 kc for position "C" and 450 kc for position "M".

l. Disconnect frequency meter from, and connect vtvm probe to pin 1 of V3304.

m. Operate the hundreds "CHANNEL" select switch from position "B" through position "M", noting the vtvm reading for each position. Readings between 0.6 to 0.8 volt rms should be obtained.

n. Connect vtvm probe to pin 4 of V3304.

o. Operate the hundreds "CHANNEL" select switch from position "M" through position "B", noting the vtvm reading for each position. Readings between —2 and —4 volts dc should be obtained.

p. Disconnect all test equipment.

7–62. Alinement of L3306, C3318, L3305 and C3307. Proceed as follows:

a. Disconnect the coaxial cable from "J3503" located on the reference oscillator subassembly.

b. Connect vtvm ac probe to terminal 3 of T3301.

c. Connect signal generator through 0.1 uf capacitor to pin 1 of V3301.

d. Connect 0.1 uf capacitor from pin 4 of V3302 to ground.

e. Set signal generator frequency to 4.5 mc.

f. Set megacycle select switch on Radio Set Control CPC–1 to position "G". When the megacycle clutch shaft stops rotating, connect a clip load between "J3412" and ground to stop the motor.

g. Adjust signal generator output to 0.1 to 0.2 volt rms.

h. Tune C3318 for maximum indication on vtvm, adjusting the signal generator output as required to maintain a reading of 0.1 to 0.2 volt rms on the vtvm.

i. Set megacycle select switch on the radio set control to position "B" and remove the clip lead from ground. When the megacycle clutch shaft stops rotating reconnect the clip lead to ground to stop the motor.

j. Set signal generator to 2.5 mc at an output level of 0.1 to 0.2 volt rms.

k. Rock signal generator tuning control around 2.5 mc to determine where circuit is peaked. If peak is more than ±25 kc from 2.5 mc, set signal generator to 2.5 mc and tune L3306 for maximum as noted on the vtvm. Maintain signal generator output level at 0.1 to 0.2 volt rms while performing this adjustment.

l. Set megacycle select switch on the radio set control to position "G" and remove the clip lead from ground. When the megacycle clutch shaft stops rotating reconnect the clip lead to ground to stop the motor.

m. Rock signal generator tuning control around 4.5 mc and note frequency of circuit peak. If the peak

is more than ± 25 kc from 4.5 mc, set signal generator to 4.5 mc at an output level between 0.1 to 0.2 volt rms.

n. Adjust C3318 for maximum indication on the vtvm while maintaining the signal generator output level between 0.1 to 0.2 volt rms.

o. Repeat steps j through n until tracking is obtained within ± 25 kc at each end of the band. The peak frequency reading for positions "G, F, D, C," and "B" (4.5, 4.0, 3.5, 3.0, and 2.5 mc, respectively) should be within ± 50 kc for each position.

p. Connect vtvm a-c probe to pin 1 of V3301.

q. Connect signal generator to junction of R3306 and CR3302. This junction can be located at the top of terminal board TB3302. Maintain signal generator output level at approximately 0.2 volt rms for the following steps.

r. Repeat steps e and f.

s. Tune C3307 for peak as noted on vtvm. Maintain signal generator output level for a reading of 0.2 volt rms.

t. Repeat steps i and j.

u. Rock signal generator tuning control around 2.5 mc and determine frequency of peak. If the frequency peak is more than ± 25 kc of 2.5 mc, set signal generator to 2.5 mc.

v. Adjust L3305 for peak reading on vtvm while maintaining signal generator output level at 0.2 volt rms, maximum.

w. Repeat steps r through v until tracking is obtained within ± 25 kc at each end of the band. The peak frequency reading for positions "G, F, D, C," and "B" (4.5, 4.0, 3.5, 3.0, and 2.5 mc, respectively) should be within ± 50 kc for each position.

x. Disconnect signal generator and vtvm.

y. Reconnect coaxial lead to "J3503" located on the reference oscillator subassembly.

z. Connect frequency counter to pin 1 of V3302.

aa. Set megacycle select switch on radio set control to position "G" and remove clip lead from ground. When megacycle clutch shaft stops rotating, reconnect the clip lead to ground to stop motor.

ab. Reading on frequency meter should be 4.5 mc, ± 50 kc.

ac. Repeat step aa for each megacycle select switch position "F" through "B". Frequency meter readings should be within ± 50 kc of nominal reading (4.0, 3.5, 3.0, and 2.5 mc, respectively) for each position.

ad. Disconnect frequency meter.

ae. Connect a-c probe of vtvm to pin of V3302.

af. Measure vtvm reading for each megacycle select switch setting "B" through "G". Voltage measured for each switch position should be between 0.5 and 1.2 volt rms.

ag. Disconnect all test equipment.

CAUTION

The bandpass filter T3301 is prealined at the factory prior to installation in the channelizer subassembly. As this requires critical adjustment with special equipment, no attempt should be made in the field to realine T3301. Where a maladjustment or defect is noted, replace entire part.

7-63. After completion of any alinement procedures, test the channelizer subassembly in accordance with the minimum performance standards in paragraph 7-42. Make certain the subassembly performs normally before returning it to the equipment.

7-64. LUBRICATION. As long as the driving mechanism of the channelizer subassembly remains relatively clean and free of grime, no lubrication will be required. When lubrication is required, it will be necessary to apply Esso Type P16 lubricant by means of a brush to any of the accessible gears. Use only a small amount of lubricant on the brush and dab it carefully on the teeth of the selected accessible gear so as to wet surface without any runs or drips. Normal operation of the drive mechanism will transfer the lubricant to the inaccessible gears of the gear train. Caution must be exercised not to apply an excessive amount of lubricant or the excess will run into the clutch mechanisms. This is to be avoided or the clutches will not function normally. When it is necessary to clean the drive mechanism, or replace a damaged gear, the respective parts must be removed from the subassembly. The idler gears are secured to the assembly shafts by means of "C" rings and (except for the driving gear on the motor which is pinned to its shaft) all of the main driving gears are secured to their respective shafts by means of two setscrews. The order of assembly (or disassembly) of the driving mechanism is clearly shown in figure 7-24. The two electrical assemblies shown in the inset of figure 7-24 must be removed from their normal mounting positions and placed to one side in order to attain access to the driving mechanism. Caution must be exercised in removing these subassemblies or damage to the interconnecting wires may result. If ever it becomes necessary to clean any of the gears, proceed as follows:

a. Remove the gear from its shaft. See figure 7-24 for removal hardware.

b. Lower the gear in a non-petroleum type of solvent so that its teeth and sides only are immersed. Do not allow the solvent to enter the bearing as the bearing contains permanent lubrication.

c. Rotate the gear in the solvent until all teeth and sides are clean.

d. After cleaning and drying, replace the gear on its drive shaft and secure in place by means of its securing hardware.

e. Lightly lubricate the teeth of the cleansed gear with Esso Type P16 lubricant.

7–65. DETAILED CIRCUIT ANALYSIS. As explained previously, the channelizer subassembly consists of electronic and electro-mechanical control circuitry. Therefore, in order to clarify the circuit analysis of this subassembly, the operation of the electronic and electro-mechanical control circuits will be explained separately. Figures 7–27 through 7–29 must be referenced in order to understand the explanation that follows:

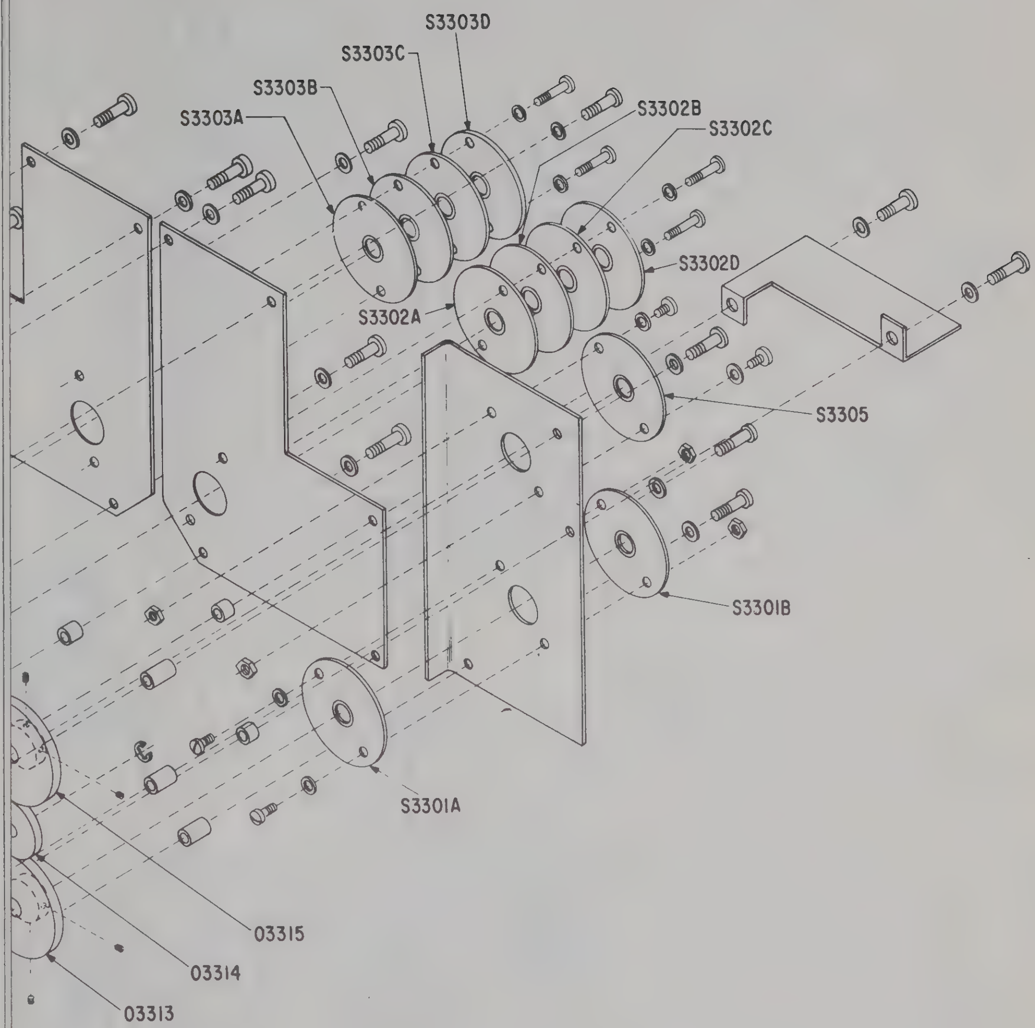
7–66. Controlled Master Oscillator and Buffer. The cmo (figure 7–27) employs a 5840 pentode tube in a feedback circuit. The oscillator portion of V3307 consists of the cathode, the control grid, and the screen grid. The screen grid acts as the oscillator plate circuit. Oscillations are sustained by means of coupling the r-f voltage variations in the screen grid back to the frequency determining network by means of the feedback winding L3314. The output frequency is determined by the selection of a combination of the switch selected capacitors C33016 through C33020 and the positioning of the variable capacitor C33021. Capacitor C33010 is used for alinement purposes only. As the oscillator plate circuit is isolated from the output plate circuit, frequency stability is improved. Coupling between the oscillator plate and output plate circuits is accomplished in the electron stream. Resistor R3349 is the plate load of the output circuit. Isolation of the oscillator plate circuit from the regulated +108-volt d-c source is accomplished by means of R3348 and C33023. Isolation of the output plate circuit, and additional isolation of the oscillator circuit is provided by R3350, C33030, L3315, and C33025.

7–67. Fine frequency control of the oscillator stage is accomplished by means of diodes CR3309 and CR3310. These diodes act as variable capacitors which change in value in accordance with any change in the applied bias. As noted in figure 7–27, the diodes are connected across the frequency determining network which effectively places a shunt capacitance over the network. A reference bias of +9 volts dc is connected through R3345 and R3346 to the diodes. This determines the nominal shunt capacitance of the diodes as the voltage at the junction of the two diodes will be zero when the circuit is properly tuned to the selected frequency. When changing frequency, or in the event of frequency drift, the voltage at the cathode of V3405B (located in the discriminator subassembly, see paragraph 7–102) will go up or go down in accordance with the change in frequency. This change in voltage will be applied through R3343 and R3344 to the junction of CR3309 and CR3310. The change in voltage at the junction will change the bias potential applied to the diodes and cause a corresponding change in the shunt capacitance to produce a phase lock with the reference standard oscillator (see paragraph 7–112) at resonance. Capacitor C33009 serves as a bypass for the +9 volts d-c line and capacitor C33011 prevents the potential across the diodes from being shorted to ground by means of the low d-c resistance of the winding of L3313.

7–68. The output plate of V3307 is coupled to the buffer amplifier V3308 by means of C33028 and R3352. The signal is also coupled through the capacitor divider consisting of C33026 and C33027 to the suppressor grid of the number one mixer (V3302) where it is used to generate the error signal which effects automatic tuning and control. The buffer amplifier is triod connected with an r-f choke (L3316) acting as the plate load. The combination of inductance and the distributed capacitance of the winding inherent in L3316 provides a low impedance path for the master oscillator harmonics. This is desirable for operation of the multiplier stage (V1007, see paragraph 7–136) and associated tuned circuits. The buffer amplifier isolates the master oscillator stage from possible load changes caused by circuit conditions within the r-f tuner subassembly. Output of the buffer amplifier is coupled through capacitor C33029 to four stages in the r-f tuner subassembly, V1001, V1004, V1006, and V1007. The signal to V1004 and V1007 is the main signal line. The signal applied to V1001 is converted to usable information for the tuner servo amplifier subassembly which tunes all the low-level r-f amplifier and multiplier circuits as described in paragraph 7–133.

7–69. Harmonic Amplifiers and Mixers. The three harmonic amplifiers, mixers, and filter networks provide the required frequency division for tuning control of the low level circuits in the channelizer subassembly. It will be noted in figure 7–28 that the positive half of the 500-kc sine wave pulse (supplied by the reference oscillator subassembly) is connected across diode CR3302 and R3306 and through C33032 to the tuned circuit consisting of L3305 and C3307 and any one of the switch selected capacitors C3302 through C3306. The tuned circuit will be resonant at any one of the fifth through ninth harmonics of the 500-kc input (2.5 to 4.5 mc) depending upon which of the capacitors (C3302 through C3306) is switched into the circuit. The selected harmonic is coupled through capacitor C3308 to the grid of V3301 where the resultant amplified signal appears across the plate load of the tube. As the plate load consists of L3306, C3318, and C3319, and the switch selected capacitors C3313 through C3317 further selection of the desired harmonic is accomplished.

7–70. The selected harmonic from V3301 is coupled to the control grid of the number one mixer, V3302 where it combines with the output of the controlled master oscillator to produce a difference frequency within the range of 600 kc and 1100 kc. Coupling between the grid tank of the cmo and the suppressor grid of V3302 is accomplished by means of the capacitor divider consisting of C33026 and C33027. The plate load for the number one mixer is provided by the bandpass filter network T3301. This network is tuned



. *Channelizer Subassembly Drive Mechanism, Exploded View*

e. Lightly lubricate the teeth of the cleansed gear with Esso Type P16 lubricant.

7–65. DETAILED CIRCUIT ANALYSIS. As explained previously, the channelizer subassembly consists of electronic and electro-mechanical control circuitry. Therefore, in order to clarify the circuit analysis of this subassembly, the operation of the electronic and electromechanical control circuits will be explained separately. Figures 7–27 through 7–29 must be referenced in order to understand the explanation that follows:

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7–69. Harmonic Amplifiers and Mixers. The three harmonic amplifiers, mixers, and filter networks provide the required frequency division for tuning control of the low level circuits in the channelizer subassembly. It will be noted in figure 7–28 that the positive half of the 500-kc sine wave pulse (supplied by the reference oscillator subassembly) is connected across diode CR3302 and R3306 and through C33032 to the tuned circuit consisting of L3305 and C3307 and any one of the switch selected capacitors C3302 through C3306. The tuned circuit will be resonant at any one of the fifth through ninth harmonics of the 500-kc input (2.5 to 4.5 mc) depending upon which of the capacitors (C3302 through C3306) is switched into the circuit. The selected harmonic is coupled through capacitor C3308 to the grid of V3301 where the resultant amplified signal appears across the plate load of the tube. As the plate load consists of L3306, C3318, and C3319, and the switch selected capacitors C3313 through C3317 further selection of the desired harmonic is accomplished.

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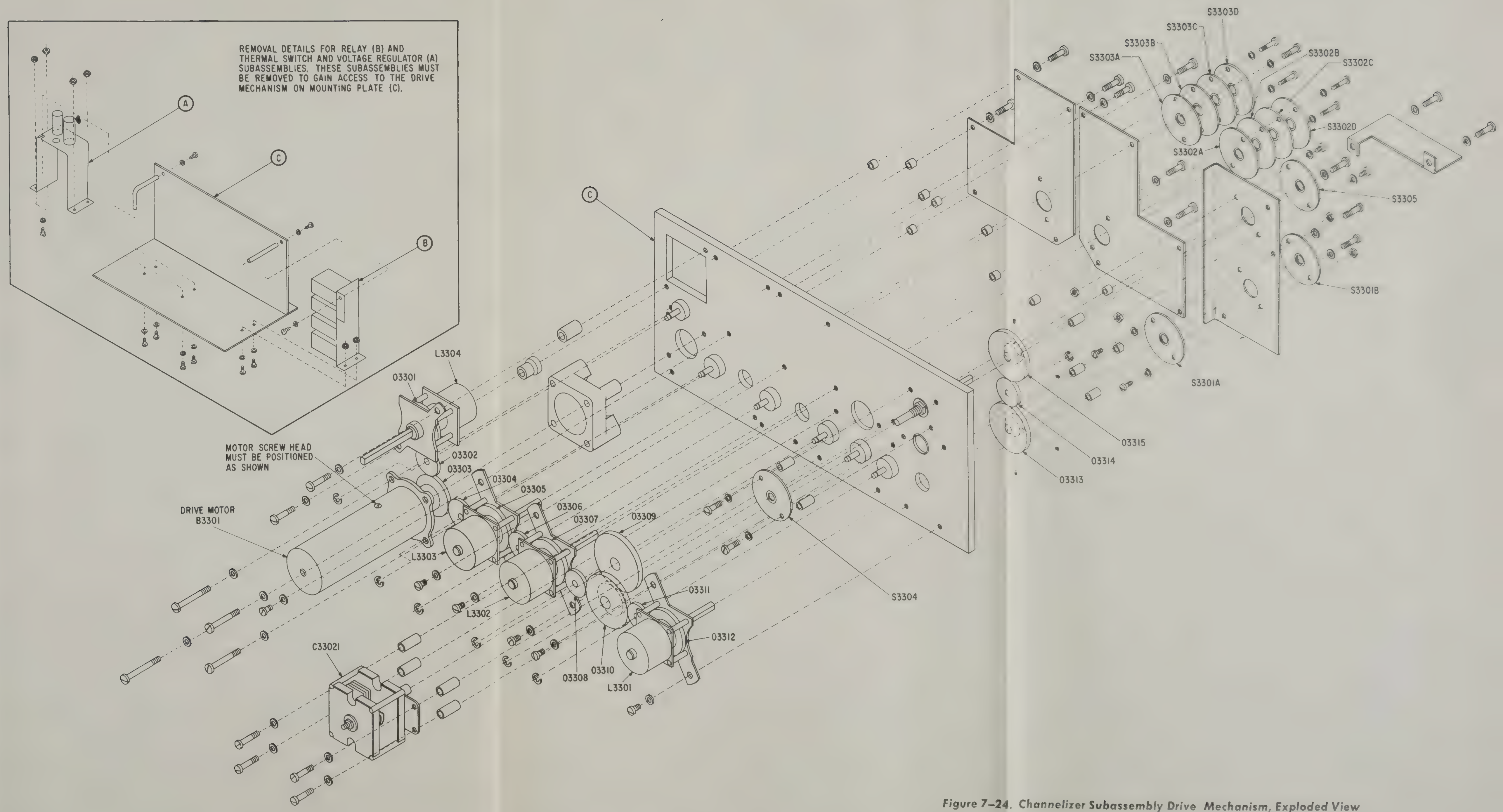


Figure 7–24. Channelizer Subassembly Drive Mechanism, Exploded View

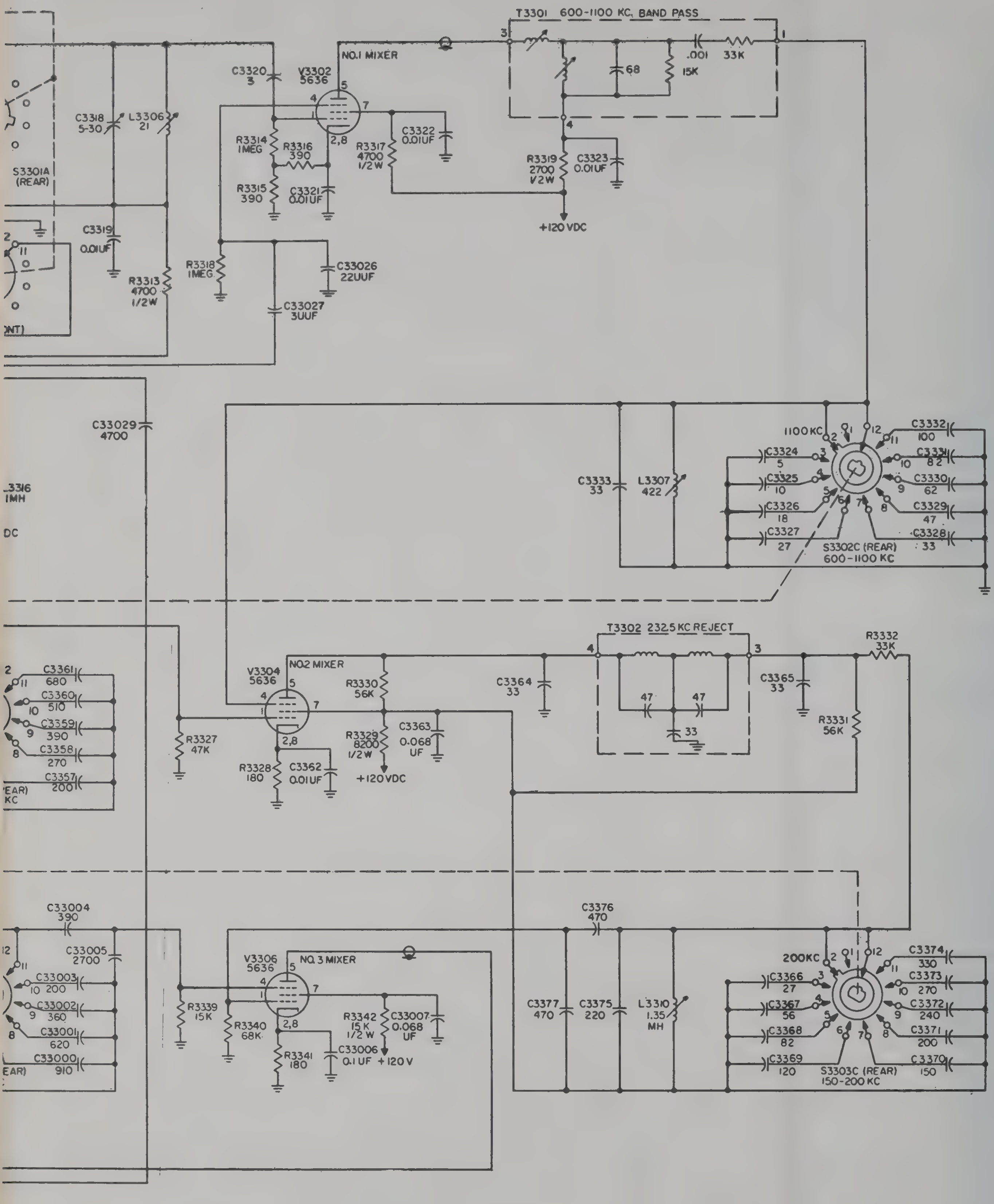
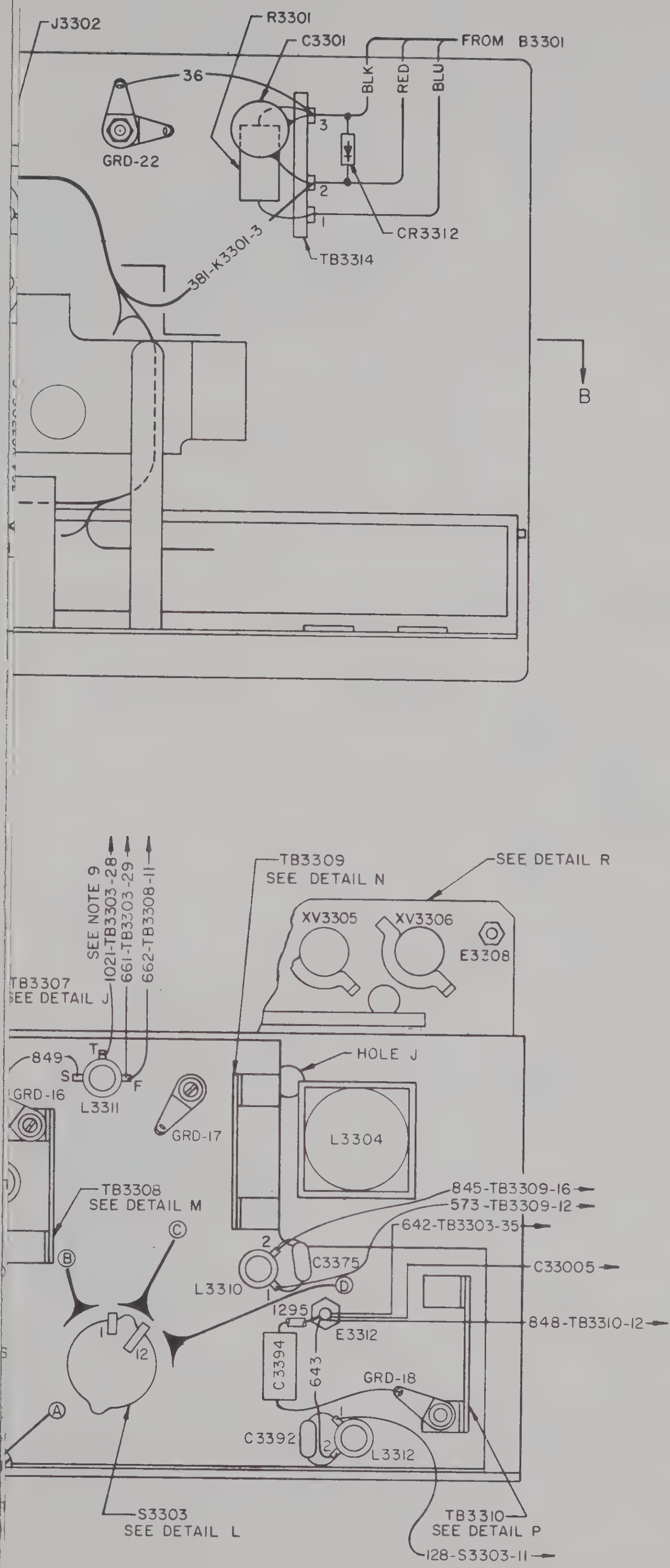
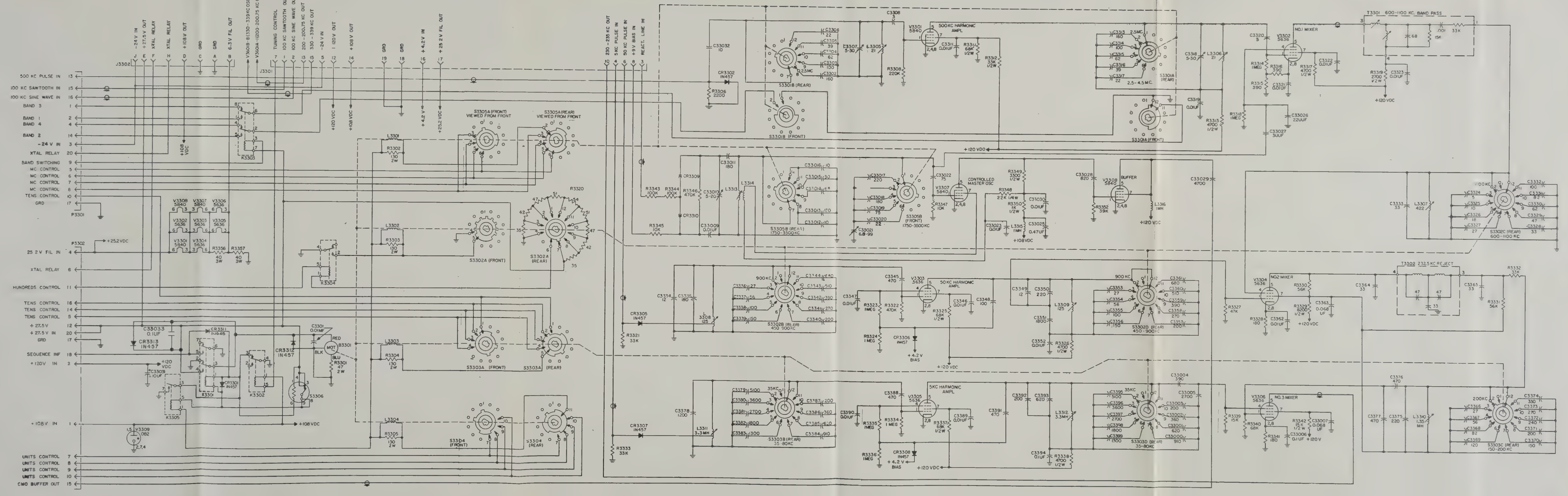


Figure 7–25. Channelizer Subassembly, Schematic Diagram

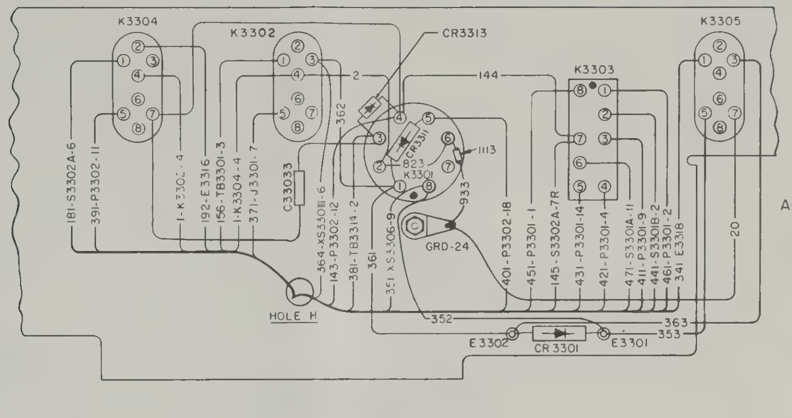


:er Subassembly, Wiring Diagram (Sheet 1 of 5)

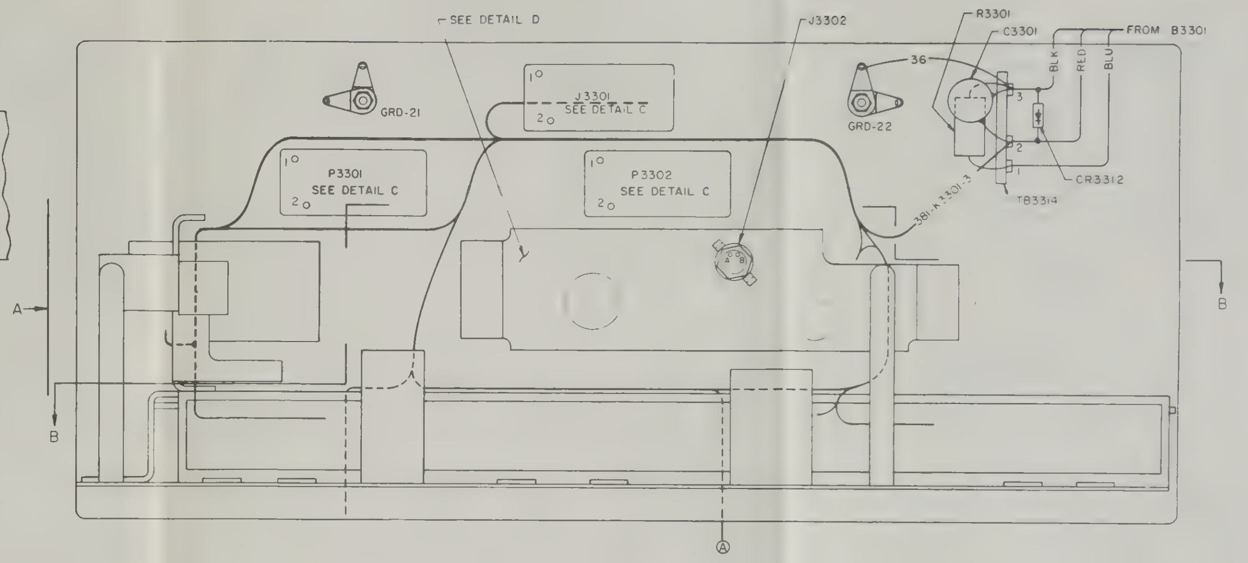


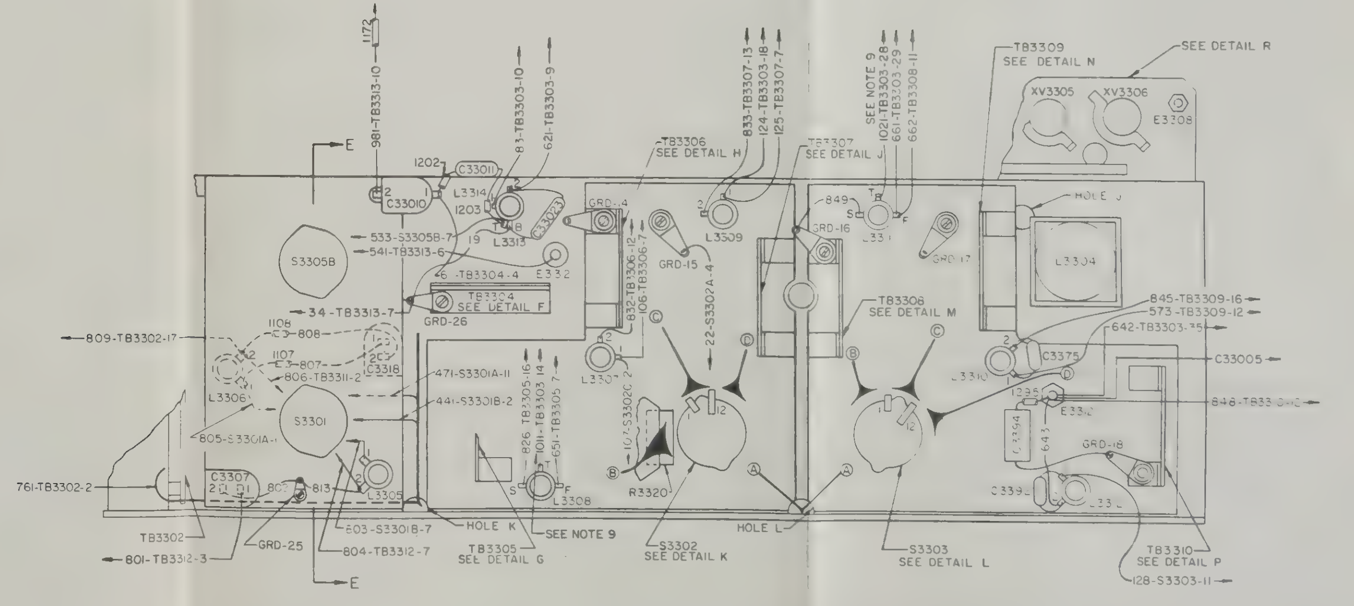
NOTES:
1 ALL CAPACITANCE VALUES ARE IN UUF UNLESS OTHERWISE INDICATED.
2 ALL INDUCTANCE VALUES ARE IN UH UNLESS OTHERWISE INDICATED.
3 ALL RESISTANCE VALUES ARE IN OHMS (K=1000 OHMS).
4 ALL RESISTORS ARE 1/4W UNLESS OTHERWISE INDICATED.
5 ALL WAFER TYPE SWITCHES ARE VIEWED FROM REAR (END OPPOSITE CONTROL OR ACTUATOR SOURCE) UNLESS OTHERWISE INDICATED.
6 THIS CAPACITOR VALUE TO BE DETERMINED BY FACTORY TEST FROM 22 TO 56 UUF.

Figure 7–25. Channelizer Subassembly, Schematic Diagram



VIEW A





NOTES

1 FORM AND LACE CABLES AS INDICATED USING LACING TAPE,
8745036-501, ITEM 54
8745037-501, ITEM 52
8314526-501, ITEM 149
8614801-501, ITEM 56

2 APPLY MOISTURE AND FUNGUS RESISTANT VARNISH TO ALL LACING KNOTS USING
8614801-501, ITEM 54
8745036-501, ITEM 55
8745037-501, ITEM 53
8314526-501, ITEM 150

3. CRIMP AND SOLDER ALL ELECTRICAL CONNECTIONS USING SOLDER
8614801-501, ITEM 53
8745036-501, ITEM 56
8745037-501, ITEM 54
8314526-501, ITEM 151

4 COVER ALL TERMINALS OF J3302 WITH SLEEVING, ITEM 148

5 FOR SCHEMATIC SEE RCA DWG 8316552-1

6. DESTINATION E3605 AND E3606 TO BE FOUND ON THE DUAL CRYSTAL OSCILLATOR DWG 8314583, LEADS 768 & 769 CONNECTED AT TIME OF ASSEMBLY.

7. COVER ALL TERMINALS OF P3301 & P3302 WITH SLEEVING ITEM 152.

8. COVER OUTSIDE TERMINALS OF J3301 WITH SLEEVING ITEM 152 & MIDDLE TERMINALS WITH SLEEVING ITEM 158.

9. THESE LEADS ARE TO BE DIRECT POINT TO POINT CONNECTIONS.

10 ALL LEADS TO HAVE MINIMUM SERVICE LOOP.

Figure 7–26. Channelizer Subassembly, Wiring Diagram (Sheet 1 of 5)

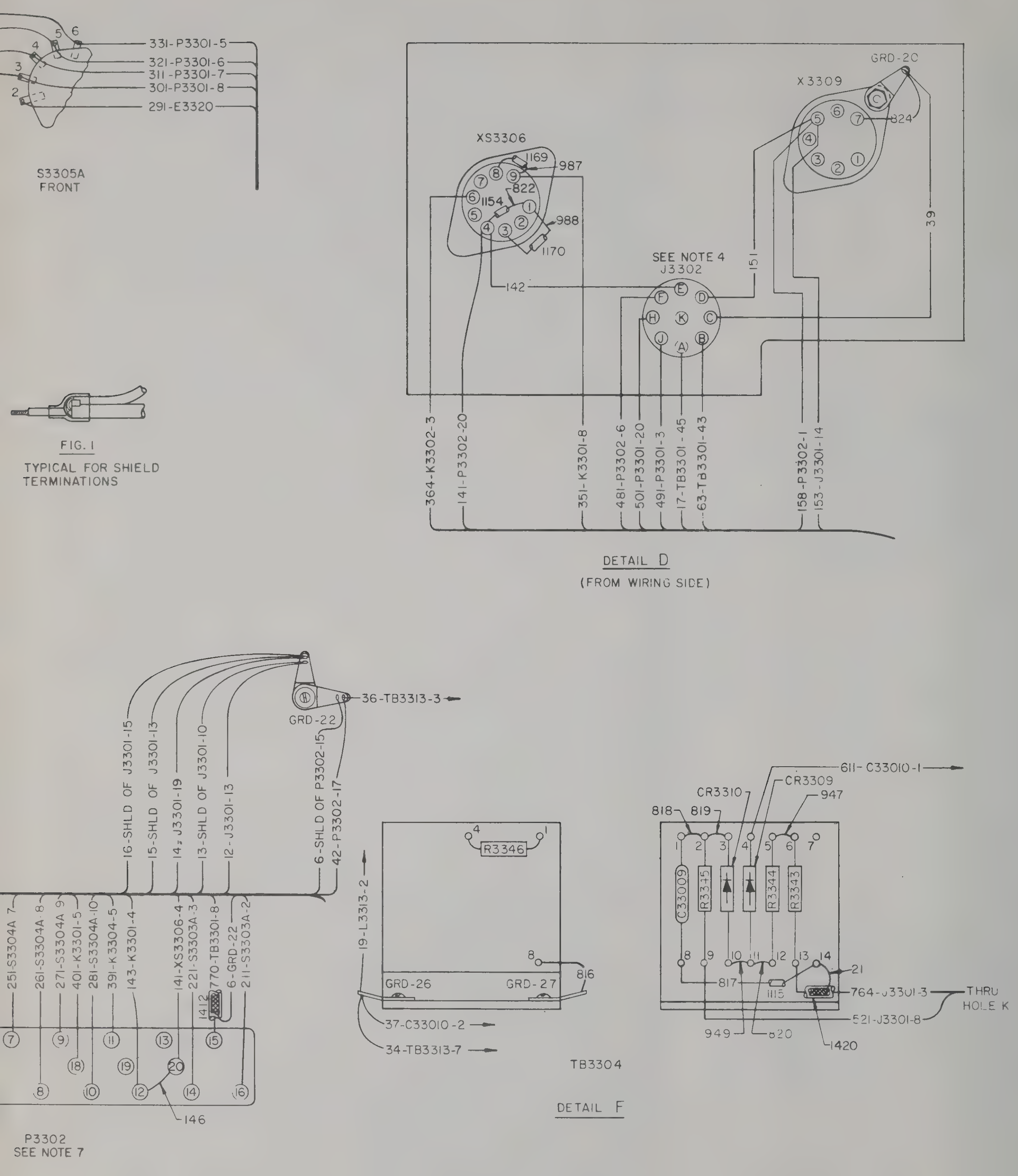
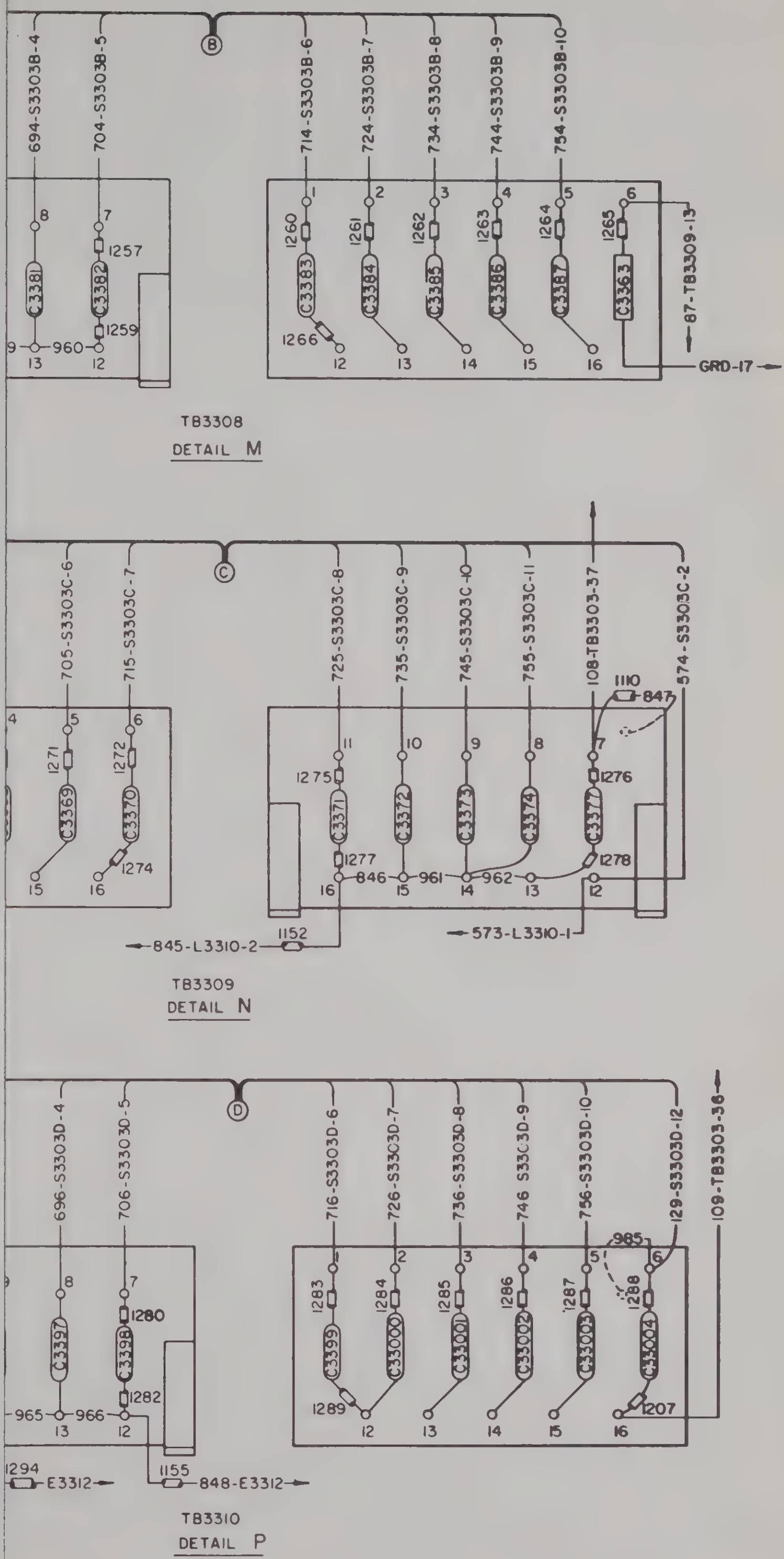


Figure 7–26. Channelizer Subassembly, Wiring Diagram (Sheet 2 of 5)



izer Subassembly, Wiring Diagram (Sheet 3 of 5)

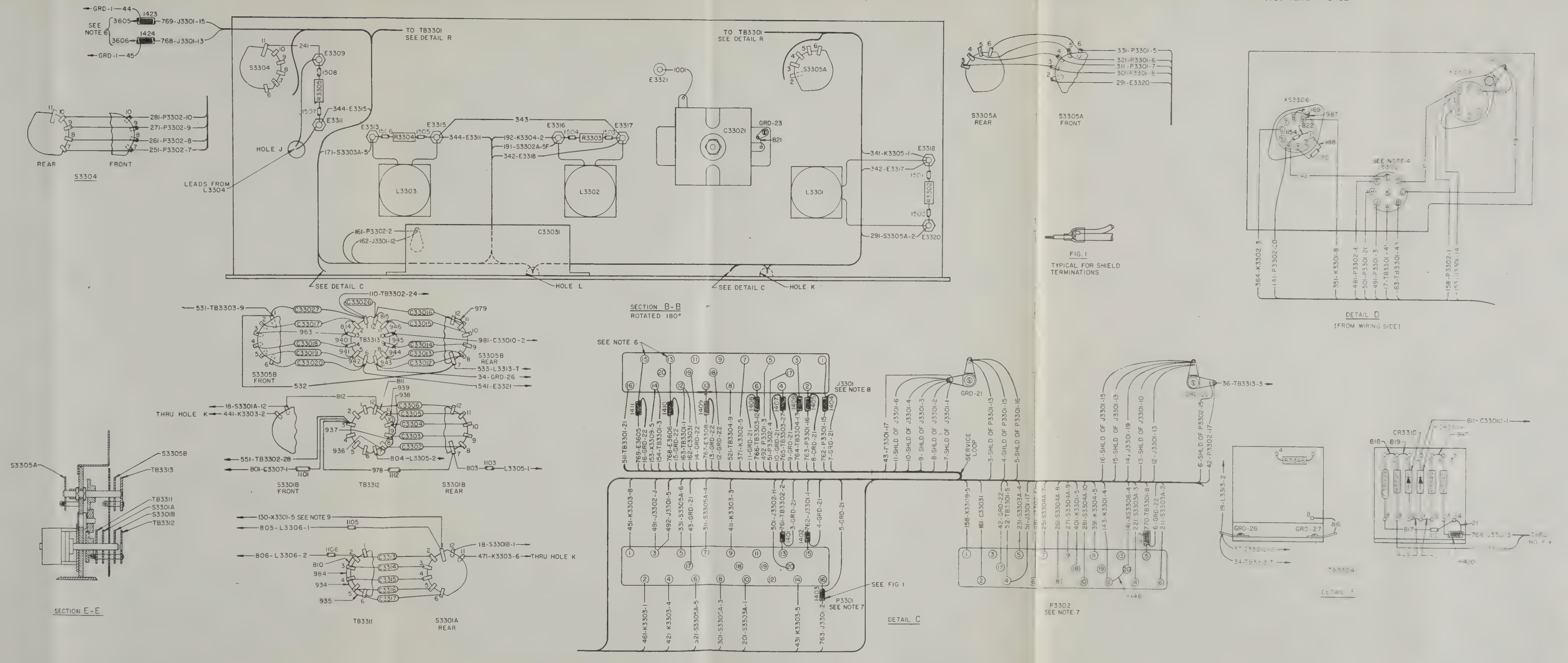


Figure 7–26. Channelizer Subassembly, Wiring Diagram (Sheet 2 of 5)

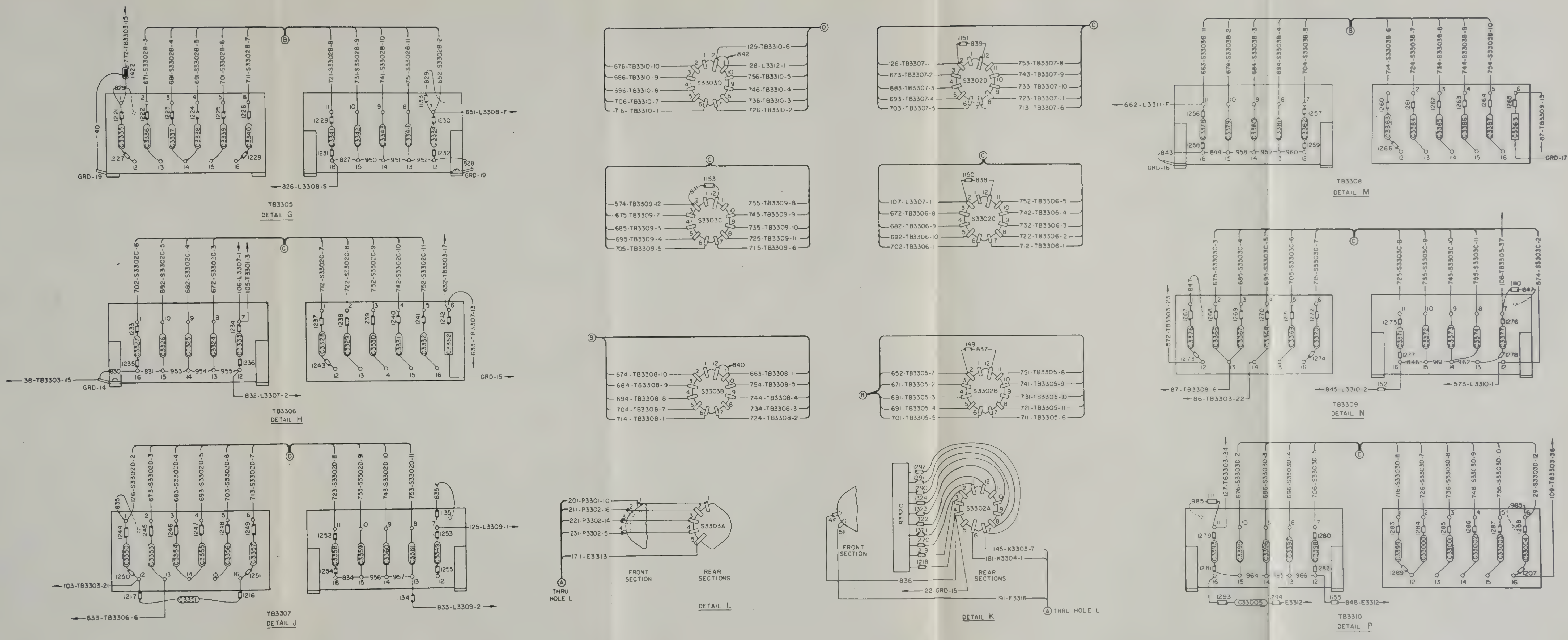


Figure 7-26. Channelizer Subassembly, Wiring Diagram (Sheet 3 of 5)

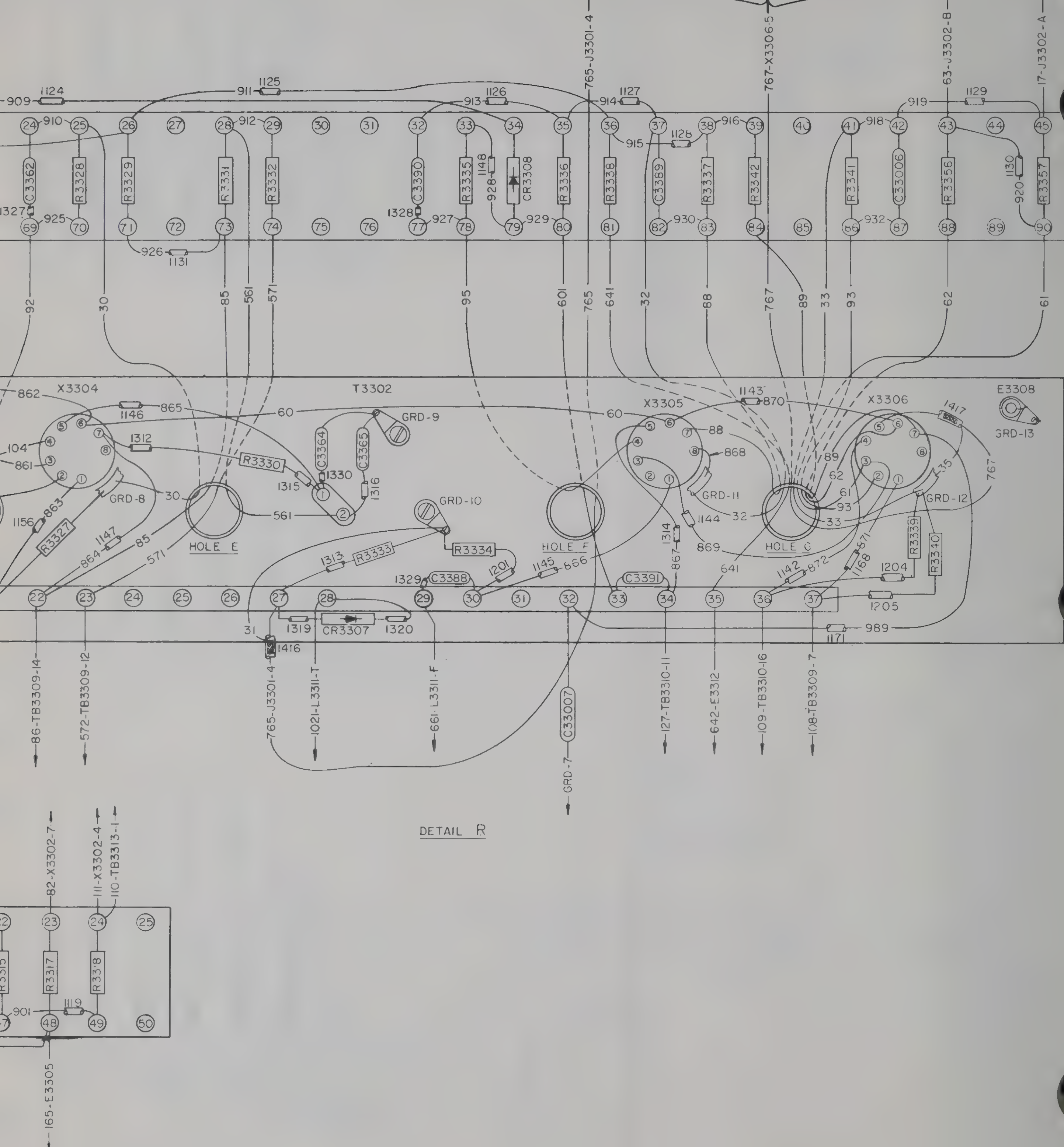


Figure 7–26. Channelizer Subassembly, Wiring Diagram (Sheet 4 of 5)

WIRE NO.'S INCLUSIVE	COLOR AND CONDUCTOR DESCRIPTION (WIRE TABLE)	PART NUMBER	8314526 -501	8745037 -501	8745036 -501	8614801 -501
1501-1508	SLEEVING, INSUL, TEFLON .063 I.D.	8418740-13	148			
1021	WHT-BRN/ORN/VIO TCR 7/.008 600V	999127-137			58	
1011	WHT-BRN/ORN/BLU TCR 7/.008 600V	999127-136		56		
1001	WIRE-TINNED COPPER .025 DIA	2010105-22	155			
1401-1424	SLEEVING, INSUL, SILICONE .076 I.D.	8977947-110	147			52
1201-1331	SLEEVING, INSUL. TEFLON .038 I.D.	8418740-8	153	55	57	55
1101-1171	SLEEVING, INSUL. TEFLON .025 I.D.	8418740-6	146	51	53	51
801-969	WIRE-TINNED COPPER .0159 DIA	2010105-26	145	50	52	50
761-772	CABLE COAX	2010744-196	144			49
751-756	WHT-BRN/ORN/GRN TCR 7/.005 600 V	999125-135		49	51	
741-746	BRN/ORN/YEL	-134		48	50	
731-736	-BRN/ORN/RED	-132		47	49	
721-726	-BRN/ORN/BLK	-130		46	48	
711-716	-BRN/RED/BLU	-126		45	47	
701-706	-BRN/RED/GRN	-125		44	46	
691-696	-BRN/RED/YEL	-124		43	45	
681-686	-BRN/RED/ORN	-123		42	44	
671-676	-BRN/RED/BLK 7/.005	999125-120		41	43	
661-663	-BLK/YEL/ORN 7/.008	999127-43			42	
651-652	-BLK/YEL/RED	-42	143	40		
641-643	-BLK/YEL/BRN	-41				48
631-633	-BLK/ORN/BLU	-36		39		47
621-622	-BLK/ORN/GRN	-35	142			46
611	-BLK/ORN/YEL	-34	141			
601	-BLK/ORN/RED	-32				45
591	-BLK/ORN/BRN	-31				44
581	-BLK/RED/BLU	-26				43
571-574	-BLK/RED/GRN	-25			41	42
561	-BLK/RED/YEL	-24				41
551	-BLK/RED/ORN	-23	140			
541-542	-BLK/RED/BRN	-21	139			
531-533	-BLK/BRN/BLU	-16	138			
521	-BLK/BRN/GRN	-15	137			
511	-BLK/BRN/YEL	-14	136			
501	-BLK/BRN/ORN	-13	135			
491	-BLK/BRN/RED TCR	-12	134			
481	-BLU/GRN TCR	-965	133			
471	-BLU/YEL	-964	132			
461	-BLU/ORN	-963	131			
451	-BLU/RED	-962	130			
441	-BLU/BRN	-961	129			
431	-BLU/BLK	-960	128			
421	-GRN/BLU	-956	127			
411	-GRN/YEL	-954	126			
401	-GRN/ORN	-953	125			
391	-GRN/RED	-952	124			
381	-GRN/BRN	-951	123			
371	-GRN/BLK	-950	122			
361-364	-YEL/BLU	-946	121			
351-353	-YEL/GRN	-945	120			
341-344	-YEL/ORN	-943	119			
331	-YEL/RED	-942	118			
321	-YEL/BRN	-941	117			
311	-YEL/BLK	-940	116			
301	-ORN/BLU	-936	115			
291	-ORN/GRN	-935	114			
281	-ORN/YEL	-934	113			
271	-ORN/RED	-932	112			
261	-ORN/BRN	-931	111			
251	-ORN/BLK	-930	110			
241	-RED/BLU	-926	109			
231	-RED/GRN	-925			40	
221	-RED/YEL	-924			39	
211	-RED/ORN	-923			38	
201	-RED/BRN	-921			37	
191-192	-RED/BLK	-920	108	38		
181	-BRN/BLU	-916		37		
171	-BRN/GRN	-915			36	
161-166	-BRN/YEL	-914	107			40
151-158	-BRN/ORN	-913	106			39
141-145	-BRN/RED TCR	-912	105	36		
121-130	-BLU TCR	-96	104	35	35	38
101-111	-GRN	-95		34	34	37
91-95	-YEL	-94				36
81-89	-ORN	-93	103		33	35
71-72	-RED	-92	102			
51-63	-BRN	-91	101			34
1-46	WHT-BLK TCR 7/.008 600 V	999127-90	100	33		33
			ITEM NUMBERS			

Figure 7–26. Channelizer Subassembly, Wiring Diagram (Sheet 5 of 5)

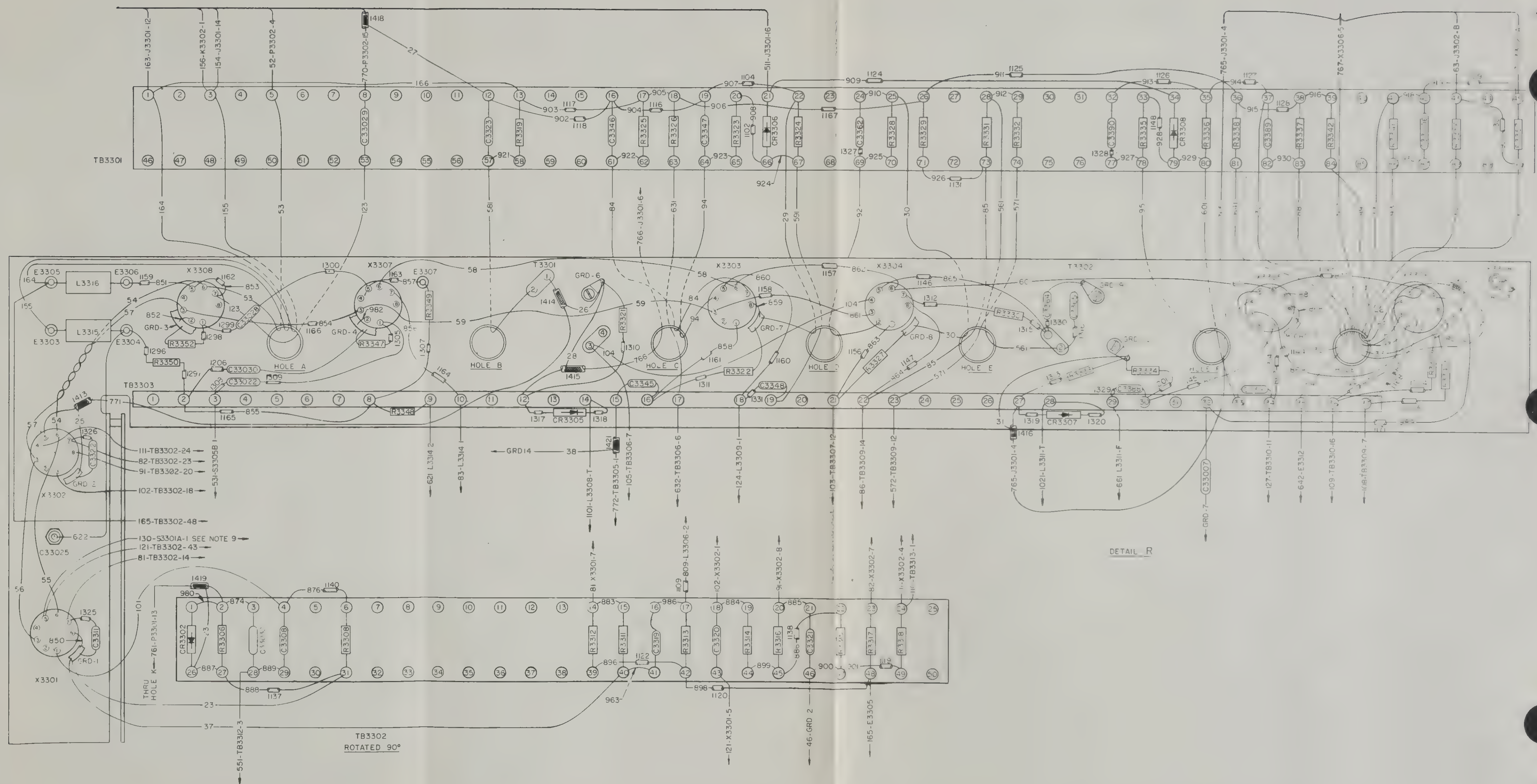


Figure 7-26. Channelizer Subassembly, Wiring Diagram (Sheet 4 of 5)

WIRE NO.'S* INCLUSIVE	COLOR AND CONDUCTOR DESCRIPTION			PART NUMBER	8314526 -501	8745037 -501	8745036 -501	8614801 -501
1501-1508	SLEEVING, INSUL, TEFLON	.063 I.D.		8418740-13	148			
1021	WHT-BRN/ORN/VIO TCR	7/.008	600V	999127-137			58	
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1001	WIRE-TINNED COPPER	.025 DIA		2010105-22	155			
1401-1424	SLEEVING, INSUL, SILICONE	.076 I.D.		8977947-110	147			52
1201-1331	SLEEVING, INSUL. TEFLON	.038 I.D.		8418740-8	153	55	57	55
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801-999	WIRE-TINNED COPPER	.0159 DIA		2010105-26	145	50	52	50
761-772	CABLE COAX			2010744-196	144			49
751-756	WHT-BRN/ORN/GRN TCR	7/.005	600 V	999125-135		49	51	
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661-663	-BLK/YEL/ORN	7/.008		999127-43			42	
651-652	-BLK/YEL/RED			-42	143	40		
641-643	-BLK/YEL/BRN			-41				48
631-633	-BLK/ORN/BLU			-36		39		47
621-622	-BLK/ORN/GRN			-35	142			46
611	-BLK/ORN/YEL			-34	141			
601	-BLK/ORN/RED			-32				45
591	-BLK/ORN/BRN			-31				44
581	-BLK/RED/BLU			-26				43
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551	-BLK/RED/ORN			-23	140			
541-542	-BLK/RED/BRN			-21	139			
531-533	-BLK/BRN/BLU			-16	138			
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481	-BLU/GRN TCR			-965	133			
471	-BLU/YEL			-964	132			
461	-BLU/ORN			-963	131			
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421	-GRN/BLU			-956	127			
411	-GRN/YEL			-954	126			
401	-GRN/ORN			-953	125			
391	-GRN/RED			-952	124			
381	-GRN/BRN			-951	123			
371	-GRN/BLK			-950	122			
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341-344	-YEL/ORN			-943	119			
331	-YEL/RED			-942	118			
321	-YEL/BRN			-941	117			
311	-YEL/BLK			-940	116			
301	-ORN/BLU			-936	115			
291	-ORN/GRN			-935	114			
281	-ORN/YEL			-934	113			
271	-ORN/RED			-932	112			
261	-ORN/BRN			-931	111			
251	-ORN/BLK			-930	110			
241	-RED/BLU			-926	109			
231	-RED/GRN			-925			40	
221	-RED/YEL			-924			39	
211	-RED/ORN			-923			38	
201	-RED/BRN			-921			37	
191-192	-RED/BLK			-920	108	38		
181	-BRN/BLU			-916		37		
171	-BRN/GRN			-915			36	
161-166	-BRN/YEL			-914	107			40
151-158	-BRN/ORN			-913	106			39
141-145	-BRN/RED TCR			-912	105	36		
121-130	-BLU TCR			-96	104	35	35	38
101-111	-GRN			-95		34	34	37
91-95	-YEL			-94				36
81-89	-ORN			-93	103		33	35
71-72	-RED			-92	102			
51-63	-BRN			-91	101			34
1-46	WHT-BLK TCR	7/.008	600 V	999127-90	100	33		33
	WIRE TABLE				ITEM NUMBERS			

Figure 7–26. Channelizer Subassembly, Wiring Diagram (Sheet 5 of 5)

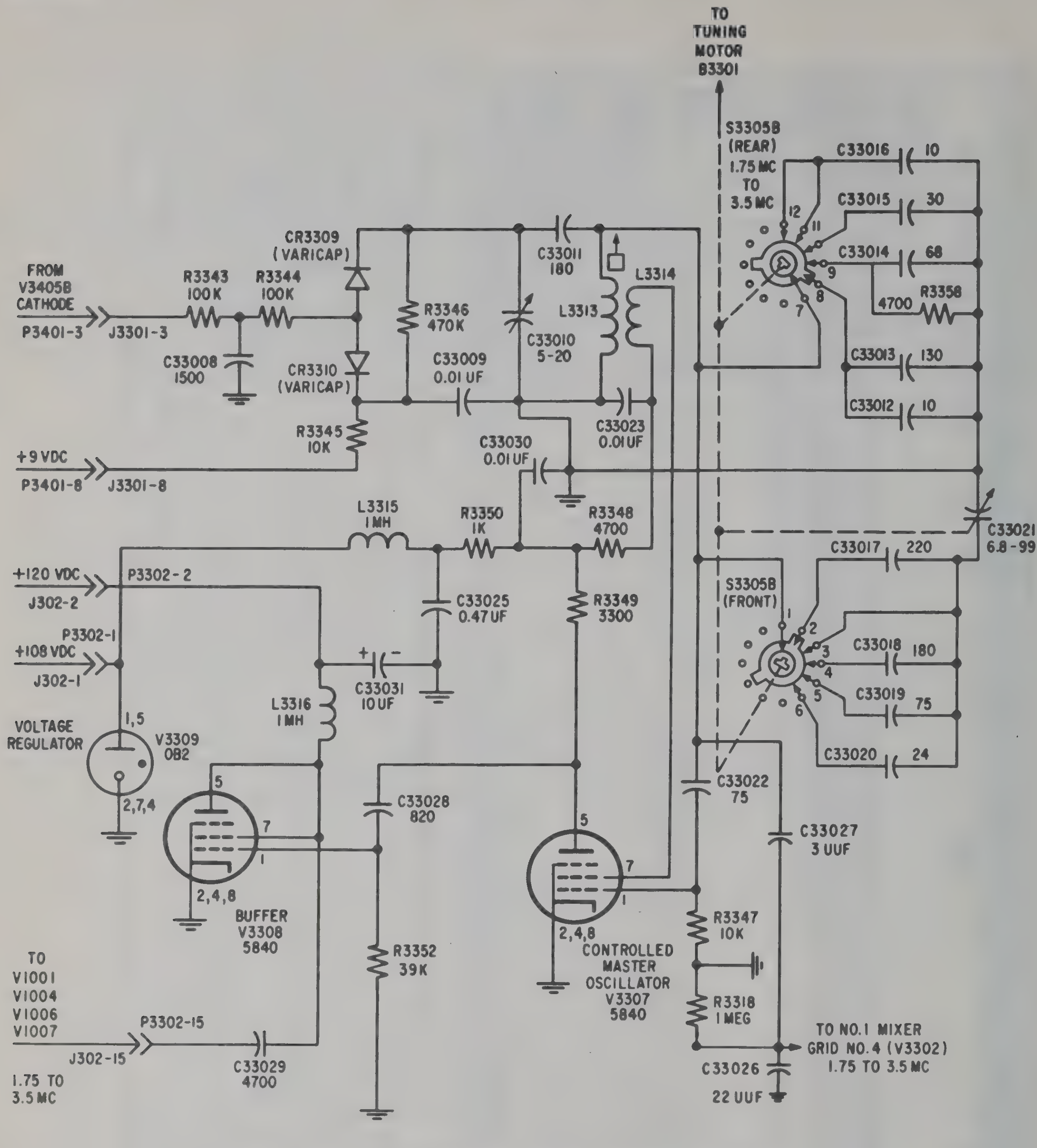
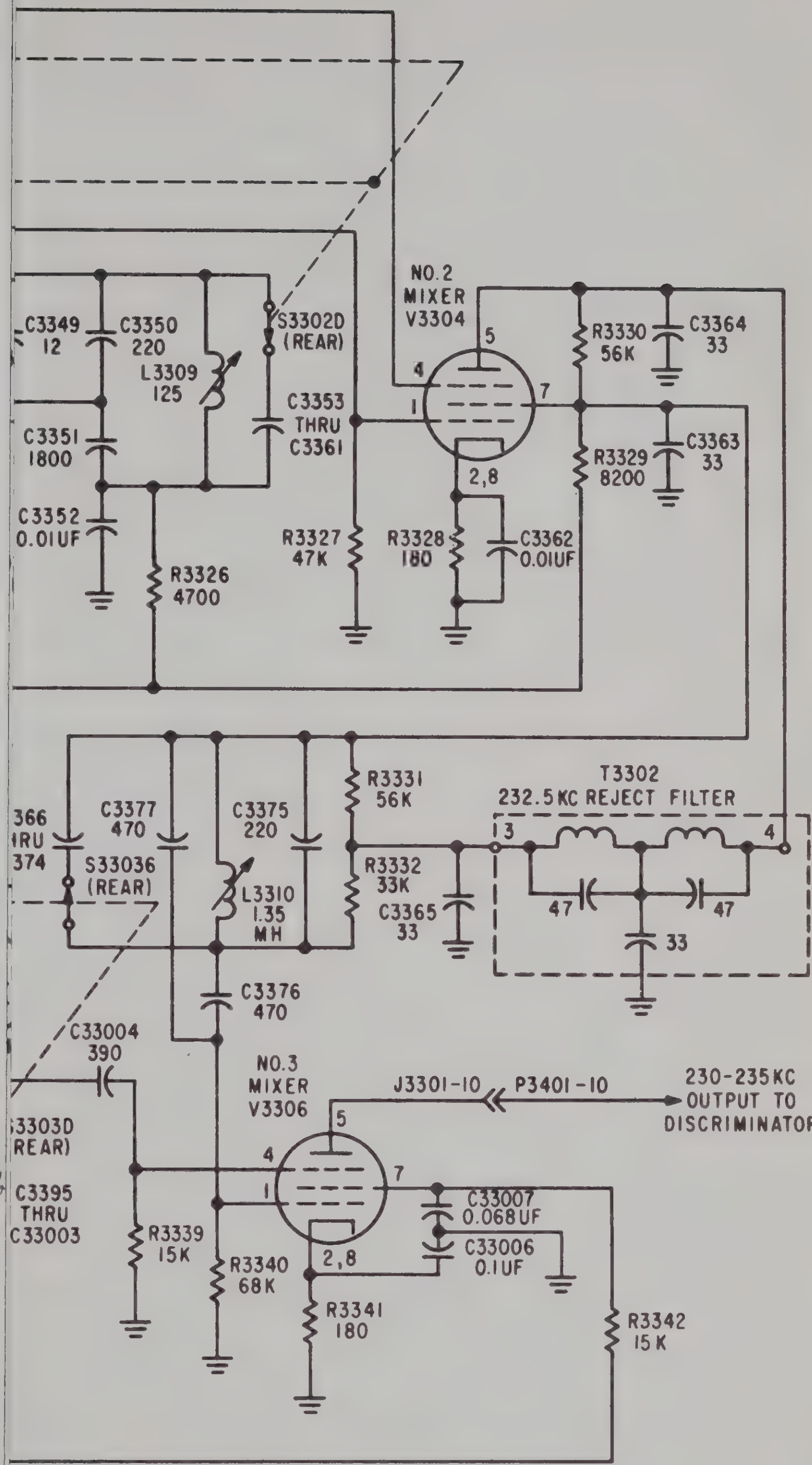


Figure 7–27. Controlled Master Oscillator and Buffer, Simplified Schematic Diagram

to pass all frequencies within the range of 600 kc to 1100 kc and attenuate all others. The output of T3301 is coupled to the tuned circuit consisting of L3307 and C3333 and the switch selected capacitors C3324 through C3332. The combination of L3307 and C3333 provides frequencies (dependent upon which of the switched capacitors is in the circuit) in 50-kc increments within the range of 600 kc and 1100 kc to the suppressor grid of the number two mixer V3304. The selected frequency is then combined with the output of V3303.

7–71. The 50-kc harmonic amplifier (V3303) is driven by the 50-kc pulse from the discriminator subassembly (refer to paragraph 7–102). Diode CR3305 passes the positive half of the 50-kc pulse to the resonant circuit consisting of L3308, C3334, and C3335, and the switch selected capacitors C3336 through C3344. This tuned circuit will be resonant at any one of the ninth through eighteenth harmonics (450 kc through 900 kc) of the 50-kc input depending upon which of the capacitors (C3336 through C3334) is switched into the circuit.



ıd Mixer Amplifiers, Simplified Schematic Diagram

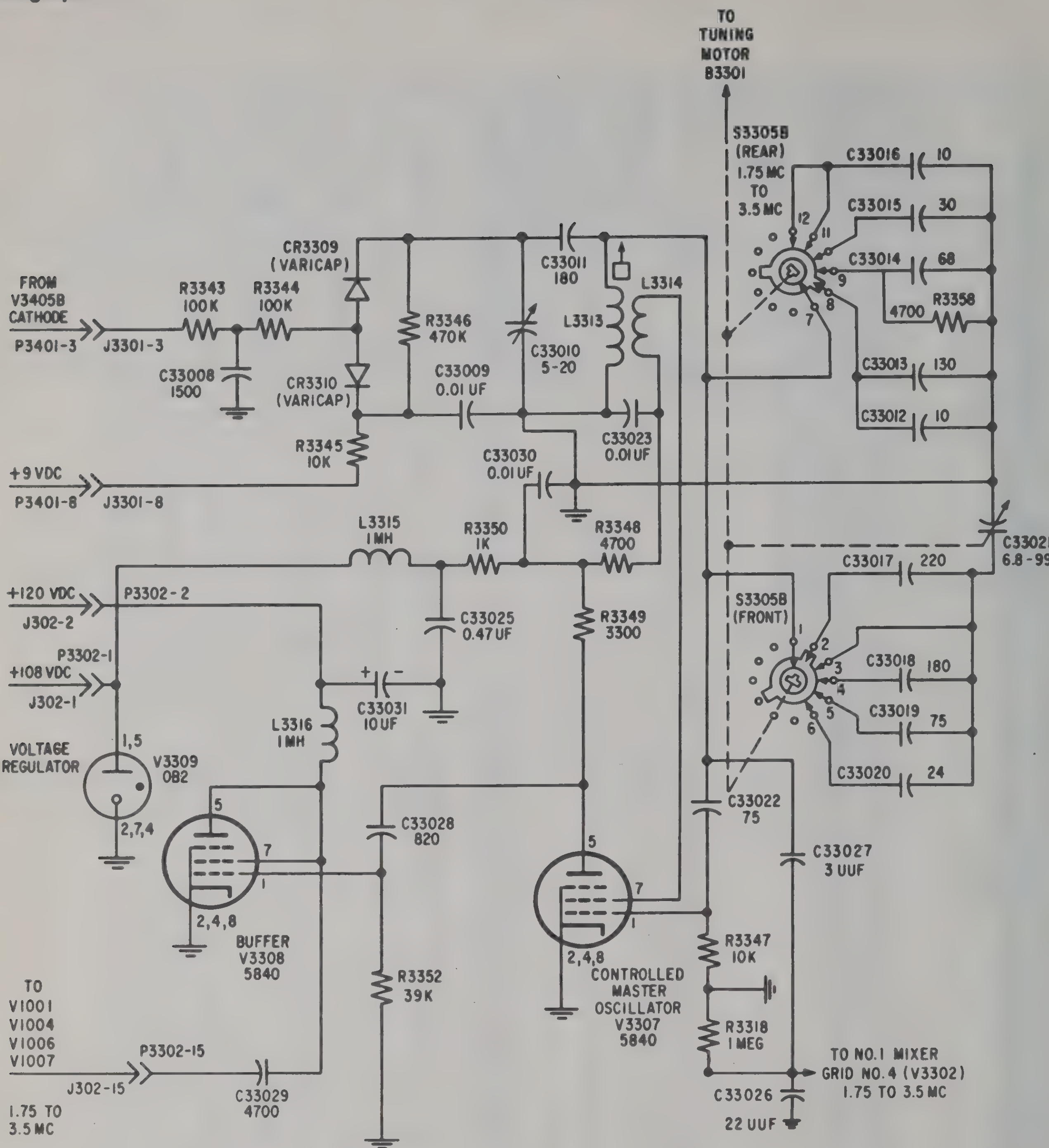


Figure 7–27. Controlled Master Oscillator and Buffer, Simplified Schematic Diagram

to pass all frequencies within the range of 600 kc to 1100 kc and attenuate all others. The output of T3301 is coupled to the tuned circuit consisting of L3307 and C3333 and the switch selected capacitors C3324 through C3332. The combination of L3307 and C3333 provides frequencies (dependent upon which of the switched capacitors is in the circuit) in 50-kc increments within the range of 600 kc and 1100 kc to the suppressor grid of the number two mixer V3304. The selected frequency is then combined with the output of V3303.

7–71. The 50-kc harmonic amplifier (V3303) is driven by the 50-kc pulse from the discriminator subassembly (refer to paragraph 7–102). Diode CR3305 passes the positive half of the 50-kc pulse to the resonant circuit consisting of L3308, C3334, and C3335, and the switch selected capacitors C3336 through C3344. This tuned circuit will be resonant at any one of the ninth through eighteenth harmonics (450 kc through 900 kc) of the 50-kc input depending upon which of the capacitors (C3336 through C3334) is switched into the circuit.

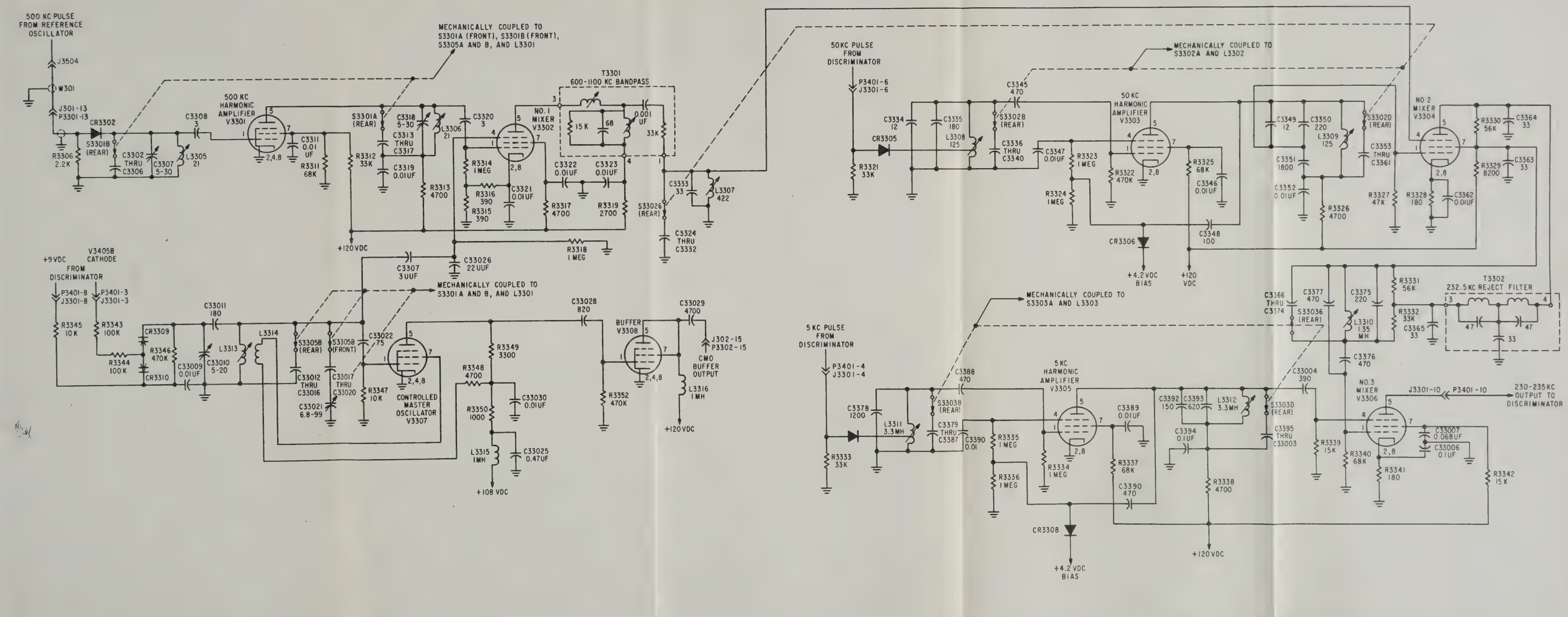


Figure 7-28. Harmonic and Mixer Amplifiers, Simplified Schematic Diagram

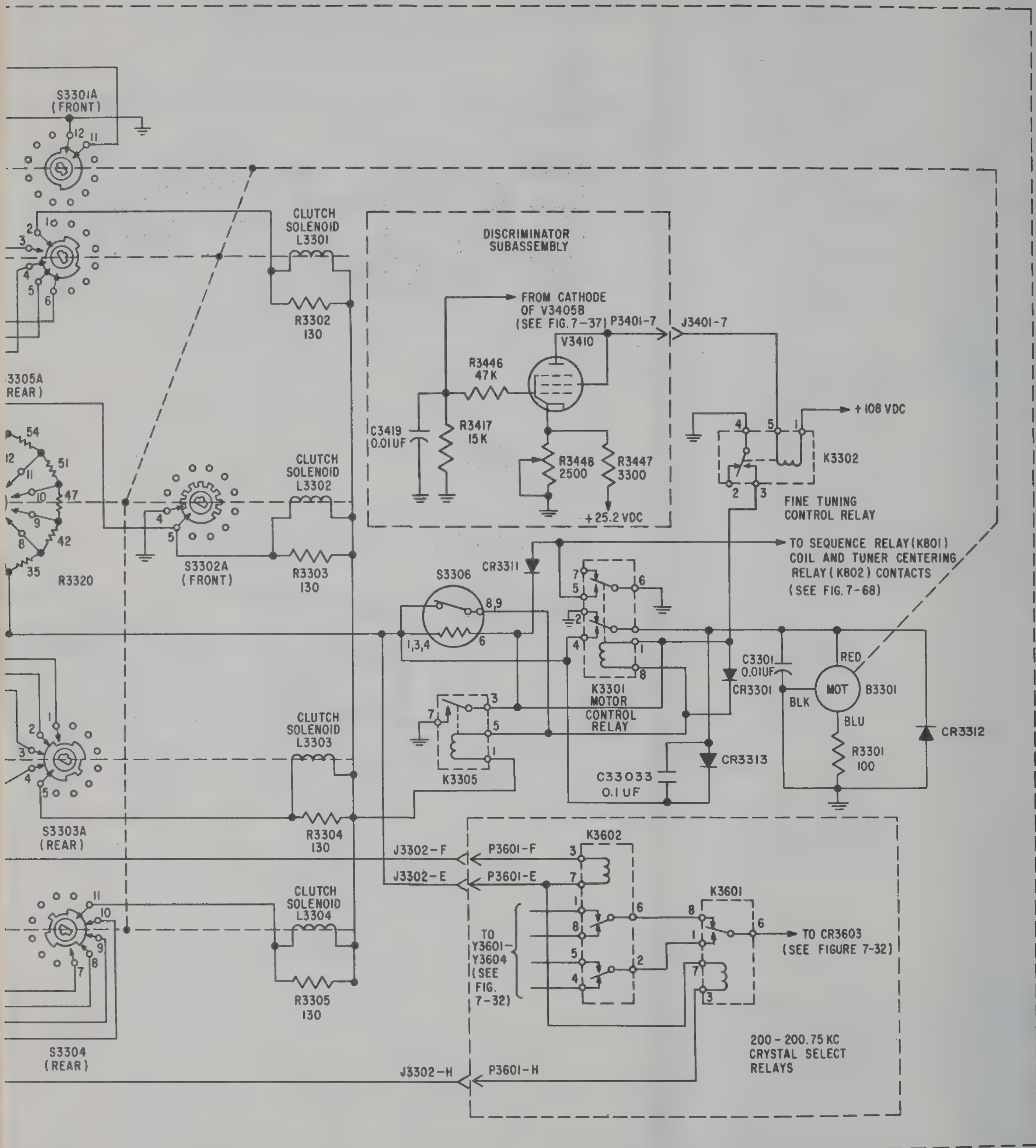


Figure 7–29. Electro-Mechanical Circuits, Simplified Schematic Diagram

The selected harmonic is coupled through capacitor C3345 to the grid of V3303 where the amplified signal appears across the plate load of the tube. The plate load consists of L3309, C3349, C3350, and C3351 and the switch selected capacitors C3353 through C3361. As the plate circuit is also resonated to the same harmonic as the grid circuit, further selection of the desired harmonic is accomplished. The output of V3303 is coupled by means of the capacitive divider consisting of C3349, C3350, and C3351 to the grid circuit of the number two mixer, V3304. By combining the output of V3302 with the output of V3303 in V3304, a difference frequency within the range of 150 kc and 200 kc is obtained. Any selected frequency within this range will pass through the reject filter T3302 to the tuned circuit consisting of L3310 and C3375 and the switch selected capacitors C3366 through C3374. The tuned circuit is then coupled through capacitor C3376 to the grid of V3306. The reject filter consists of a low-pass, M-derived network designed to sharply attenuate a frequency of 232.5 kc. This frequency must be rejected or it will combine with the signals in the number three mixer V3306 to cause spurious beats which could result in improper tuning of the equipment.

7-72. The level at the grid of V3304 is held constant by means of the biasing network consisting of C3348, CR3306, R3323, and R3324. It will be noted in figure 7-28 that the output signal from V3303 is coupled through C3348 to the junction of CR3306, R3323, and R3324. A positive voltage of +4.2 volts provides reverse bias to diode CR3306. This sets the threshold of operation. If the signal at the plate of V3303 is greater than +4.2 volts, the diode will conduct. This will change the bias level applied to the suppressor grid of V3303, reducing its conduction and therefore the output at the plate.

7-73. The 5-kc harmonic amplifier (V3305) is driven by the 5-kc pulse from the discriminator subassembly (refer to figure 7-102). Except for the parts symbol designations, this circuit operates the same as that described in paragraph 7-71 for the 50-kc harmonic amplifier. The selected harmonic output within the range of 35 kc to 80 kc is coupled to the suppressor grid of the number three mixer (V3306) through the capacitive divider consisting of C33004 and C33005. The combination of the output of the number two mixer with the output of V3305 in the number three mixer provides a frequency within the range of 230 to 235 kc. This frequency output appearing at the plate of V3306 is then connected to the doubler input circuit in the discriminator subassembly. For a description of the further processing of this signal, refer to paragraph 7-102.

7-74. Electro-Mechanical Circuits. It will be noted in figure 7-29 that the electro-mechanical circuits of the radio set are distributed between Radio Set Control CPC-1 and various subassemblies in the receiver-transmitter. Channeling a new frequency consists primarily of completing circuits to ground. When a ground is supplied from S3801B rear, either directly, or through the contacts of S3801B front, to the contacts of S3305A front and rear, the clutch solenoid L3301 is energized. As the common return of L3301 is through the coil of K3305 to +27.5 volts, the relay will be energized. The closing contacts of K3305 supplies a ground to the coil of the motor control relay K3301, causing its contacts to close. When closed, one set of contacts supplies 27.5 volts to the motor causing the latter to rotate, and a second set of contacts completes the ground circuit to the sequence relay (K801) coil and tuner centering relay (K802) contacts (see figure 7-68 and refer to paragraph 7-204 for operation of these relays). Rotation of the motor (B3301) causes the shafts of the switches ganged with L3301 to rotate until a switch position is reached which opens the circuit to ground. When this occurs, L3301, and K3305 will be deenergized, and the clutch mechanism will lock the shaft in the desired position so that any further rotation of the motor will not change the switch settings. All other switch shafts whose clutch solenoids are not energized will be locked in place in a similar manner while the motor is rotating. The motor will be energized and continue to rotate after all clutch solenoids have been deenergized until fine tuning of the cmo has been completed. Continuation of rotation of the motor is accomplished by applying the difference voltage from the output of the discriminator subassembly (see paragraph 7-102 and figure 7-37) to the grid of V3410. When a difference voltage is present, the tube is cut off, and the current through the coil of relay K3302 is reduced sufficiently to deenergize the relay. This causes the relay contacts to complete a ground circuit to the coil of K3301 energizing the latter. The closed contacts on K3301 completes the d-c circuit to the motor and the ground circuit to K801 and K802 as described previously. The motor will rotate the variable capacitor in the cmo until proper resonance is obtained. When this occurs, there will be no difference voltage at the grid of V3410, the tube will conduct, K3302 will be energized because of the rise in current through the coil, and the contacts of K3302 will open the ground circuit to the coil of K3301. With the latter relay deenergized, the voltage to the motor is removed and the motor will cease to operate.

7-75. Manual rotation of switches S3803B front and rear and S3804A front and rear (located in the radio set control) will supply ground circuits through switches S3303A front and rear, and S3304 front and rear, to the clutch solenoids L3303 and L3304. These clutch solenoids will then be energized and operation of the motor through the contacts of K3301 and K3305 will be as described previously.

7-76. Operation of the clutch solenoid L3302 is achieved by means of bridge circuitry. One-half of the bridge is located in the radio set control and consists of selector switch S3802A front and the resistance string R3802. The other half of the bridge is located in the

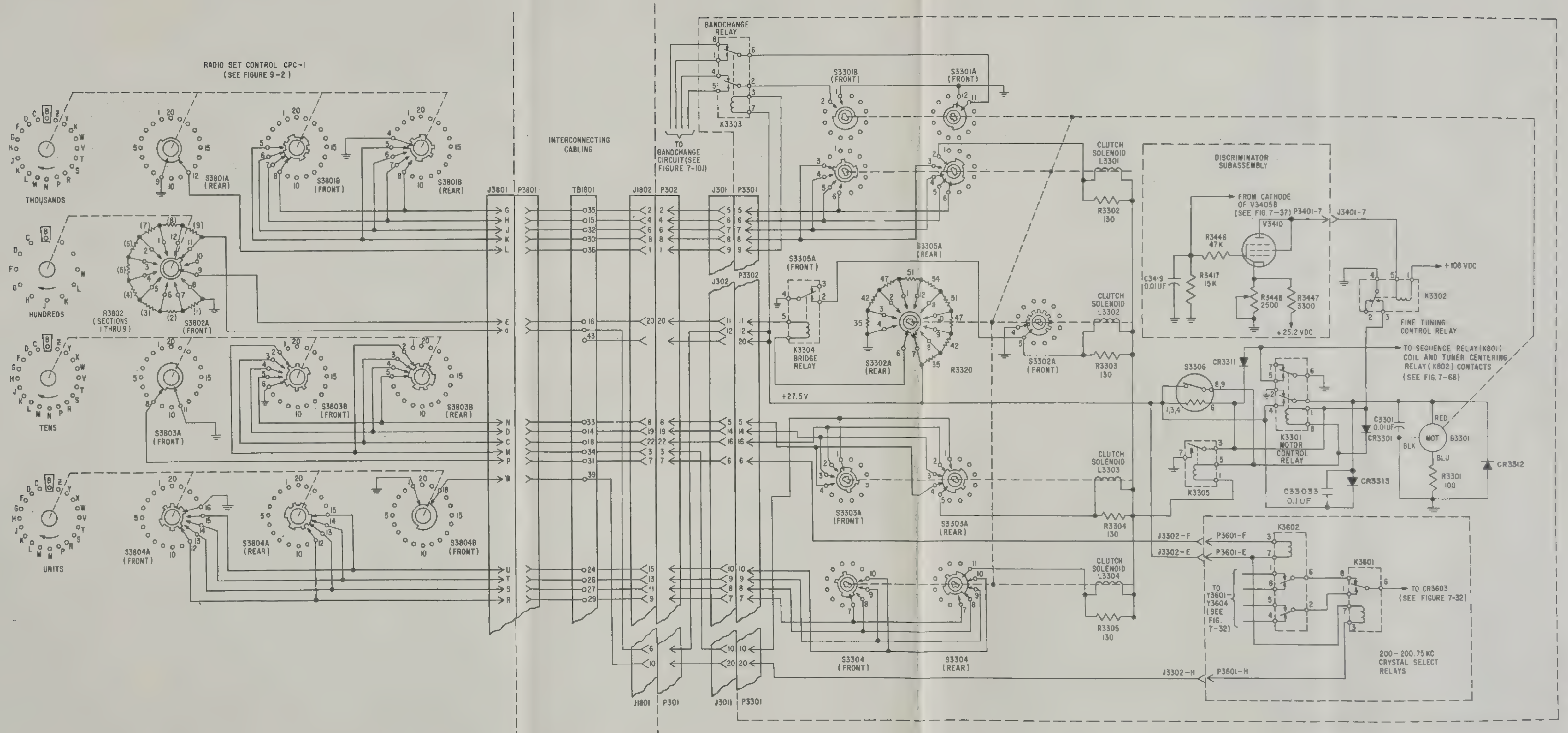


Figure 7–29. Electro-Mechanical Circuits, Simplified Schematic Diagram

The selected harmonic is coupled through capacitor C3345 to the grid of V3303 where the amplified signal appears across the plate load of the tube. The plate load consists of L3309, C3349, C3350, and C3351 and the switch selected capacitors C3353 through C3361. As the plate circuit is also resonated to the same harmonic as the grid circuit, further selection of the desired harmonic is accomplished. The output of V3303 is coupled by means of the capacitive divider consisting of C3349, C3350, and C3351 to the grid circuit of the number two mixer, V3304. By combining the output of V3302 with the output of V3303 in V3304, a difference frequency within the range of 150 kc and 200 kc is obtained. Any selected frequency within this range will pass through the reject filter T3302 to the tuned circuit consisting of L3310 and C3375 and the switch selected capacitors C3366 through C3374. The tuned circuit is then coupled through capacitor C3376 to the grid of V3306. The reject filter consists of a low-pass, M-derived network designed to sharply attenuate a frequency of 232.5 kc. This frequency must be rejected or it will combine with the signals in the number three mixer V3306 to cause spurious beats which could result in improper tuning of the equipment.

7-72. The level at the grid of V3304 is held constant by means of the biasing network consisting of C3348, CR3306, R3323, and R3324. It will be noted in figure 7-28 that the output signal from V3303 is coupled through C3348 to the junction of CR3306, R3323, and R3324. A positive voltage of +4.2 volts provides reverse bias to diode CR3306. This sets the threshold of operation. If the signal at the plate of V3303 is greater than +4.2 volts, the diode will conduct. This will change the bias level applied to the suppressor grid of V3303, reducing its conduction and therefore the output at the plate.

7-73. The 5-kc harmonic amplifier (V3305) is driven by the 5-kc pulse from the discriminator subassembly (refer to figure 7-102). Except for the parts symbol designations, this circuit operates the same as that described in paragraph 7-71 for the 50-kc harmonic amplifier. The selected harmonic output within the range of 35 kc to 80 kc is coupled to the suppressor grid of the number three mixer (V3306) through the capacitive divider consisting of C33004 and C33005. The combination of the output of the number two mixer with the output of V3305 in the number three mixer provides a frequency within the range of 230 to 235 kc. This frequency output appearing at the plate of V3306 is then connected to the doubler input circuit in the discriminator subassembly. For a description of the further processing of this signal, refer to paragraph 7-102.

7-74. Electro-Mechanical Circuits. It will be noted in figure 7-29 that the electro-mechanical circuits of the radio set are distributed between Radio Set Control CPC-1 and various subassemblies in the receiver-transmitter. Channeling a new frequency consists primarily of completing circuits to ground. When a ground is supplied from S3801B rear, either directly, or through the contacts of S3801B front, to the contacts of S3305A front and rear, the clutch solenoid L3301 is energized. As the common return of L3301 is through the coil of K3305 to +27.5 volts, the relay will be energized. The closing contacts of K3305 supplies a ground to the coil of the motor control relay K3301, causing its contacts to close. When closed, one set of contacts supplies 27.5 volts to the motor causing the latter to rotate, and a second set of contacts completes the ground circuit to the sequence relay (K801) coil and tuner centering relay (K802) contacts (see figure 7-68 and refer to paragraph 7-204 for operation of these relays). Rotation of the motor (B3301) causes the shafts of the switches ganged with L3301 to rotate until a switch position is reached which opens the circuit to ground. When this occurs, L3301, and K3305 will be deenergized, and the clutch mechanism will lock the shaft in the desired position so that any further rotation of the motor will not change the switch settings. All other switch shafts whose clutch solenoids are not energized will be locked in place in a similar manner while the motor is rotating. The motor will be energized and continue to rotate after all clutch solenoids have been deenergized until fine tuning of the cmo has been completed. Continuation of rotation of the motor is accomplished by applying the difference voltage from the output of the discriminator subassembly (see paragraph 7-102 and figure 7-37) to the grid of V3410. When a difference voltage is present, the tube is cut off, and the current through the coil of relay K3302 is reduced sufficiently to deenergize the relay. This causes the relay contacts to complete a ground circuit to the coil of K3301 energizing the latter. The closed contacts on K3301 completes the d-c circuit to the motor and the ground circuit to K801 and K802 as described previously. The motor will rotate the variable capacitor in the cmo until proper resonance is obtained. When this occurs, there will be no difference voltage at the grid of V3410, the tube will conduct, K3302 will be energized because of the rise in current through the coil, and the contacts of K3302 will open the ground circuit to the coil of K3301. With the latter relay deenergized, the voltage to the motor is removed and the motor will cease to operate.

7-75. Manual rotation of switches S3803B front and rear and S3804A front and rear (located in the radio set control) will supply ground circuits through switches S3303A front and rear, and S3304 front and rear, to the clutch solenoids L3303 and L3304. These clutch solenoids will then be energized and operation of the motor through the contacts of K3301 and K3305 will be as described previously.

7-76. Operation of the clutch solenoid L3302 is achieved by means of bridge circuitry. One-half of the bridge is located in the radio set control and consists of selector switch S3802A front and the resistance string R3802. The other half of the bridge is located in the

channelizer subassembly and consists of switch S3302A and the resistance string R3320. D-C voltage is connected to one end of each of the resistance strings and ground to the other. When S3802A front is rotated to a new position, a difference of potential exists between the arms of switches S3802A front and S3302A rear. As this difference of potential appears across the coil of the bridge control relay (K3304), the latter will be energized. When this occurs, the closed contacts complete the ground circuit through the contacts of switch section S3302A front to the clutch solenoid L3302. This causes current to flow through L3302 and the coil of K3305. The closed contacts on K3305 energizes relay K3301 and the motor operates as described previously.

7–77. Selection of the desired band of operation is controlled by the setting of switch S3801A rear located in the radio set control. Depending upon the setting of this switch, relay K3303 located in the channelizer subassembly is energized or deenergized. When deenergized, the contacts of K3303 completes the ground circuit to the band-change circuit (located in the front panel subassembly) for bands 3 and 4. Selection of the particular band (3 or 4) will depend on the positioning of switch sections S3301B front and S3301A front, as the circuit to ground is completed through the contacts of these switches. As noted in figure 7–29, the ground circuit is completed through the contacts of S3301A front through contacts 6 and 8 of K3303 for band 3. Band 4 is selected when the ground circuit is completed through S3301B front through contacts 2 and 4 of K3303. When K3303 is energized by means of the setting of S3801A rear, band 1 or band 2 is selected. The band selected in this case is also dependent upon the positioning of the switches S3301B front and S3301A front.

7–78. Switch wafers S3803A front and S3804B front located in the radio set control are used to complete the ground circuits to relays K3602 and K3601, respectively. These relays are located in the dual crystal oscillator subassembly and are used to connect any one of four crystals to the input of the respective oscillator circuit. When an open circuit to ground exists, the relays are deenergized as shown in figure 7–29. In this state, crystal Y3603 is connected into the oscillator circuit. When a ground is supplied from S3804B, K3601 is energized and crystal Y3604 is connected into the circuit. With K3602 energized and K3601 deenergized, crystal Y3602 is selected and when both relays are energized, Y3601 is the selected crystal.

7–79. In order to prevent damage to the motor, thermal switch S3306 is provided. Voltage for operation of the motor control relays K3301 and K3305 is supplied through the contacts of S3306. It will be noted in figure 7–29, that when K3305 is energized, its closed contacts complete the ground circuit to the thermal control element of S3306 and K3301. If for any reason, the motor continues to run in excess of approximately 60 seconds, or channeling is attempted more than once every minute, this element will reach sufficient temperature to cause the contacts of the switch to open. This action removes the d-c voltage from the coils of K3305 and K3301 and the motor will stop. In all cases when this occurs the function switch on the radio set control must be operated to the "OFF" position. Allow a minimum of one minute to elapse before attempting to rechannel the equipment.

Note

Diode CR3311 connected between terminals 1 and 5 of K3301 provides positive indication of the thermal switch action. When K3302 is deenergized, the diode provides a ground return for the coil of the sequence relay K801. Operation of this relay will prevent operation of the equipment in both the receive and transmit modes.

7–80. The potentiometer in the cathode circuit of V3410 is a set-up adjustment and is to be adjusted only when the tube has been replaced or a repair has been made that would affect the point of conduction of the tube. Diode CR3301 is shunted across the coil of K3301 in order to prevent inductive transients from causing erratic operation of the relay which could result in erratic operation of the drive motor. Diodes CR3312 and CR3313 and Capacitor C33033 are provided to prevent switching and inductive transits.

7–81. DUAL CRYSTAL OSCIILATOR SUBASSEMBLY.

7–82. GENERAL DATA. Reference must be made to paragraph 7–39 for a functional description of this subassembly. As this unit is an integral part of the low-level tuning control circuits and therefore, the channelizer subassembly, it must be checked as a part of the tuning control circuit checks outlined in paragraphs 7–42 and 7–45. As no lubrication is required in this subassembly, the lubrication paragraph has been omitted.

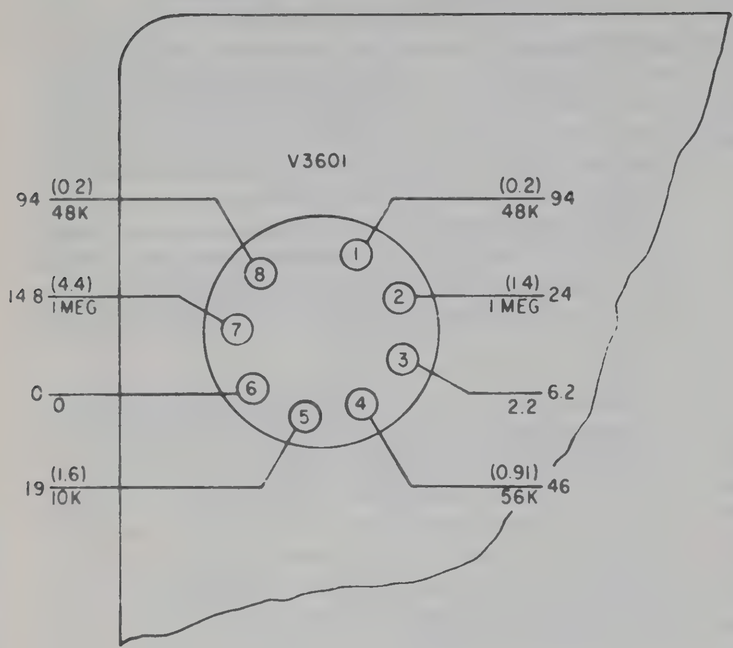
7–83. MINIMUM PERFORMANCE STANDARDS. The dual crystal oscillator subassembly is to be checked in accordance with the procedures outlined in paragraph 7–45. This check should always be made after a repair, or replacement has been made.

7–84. CHECK-OUT OR ANALYSIS. A defective part in this subassembly could cause improper tuning of the low-level circuits or frequency instability. Where these symptoms appear, check as outlined in paragraph 7–45 and if a defect is indicated, as outlined in figure 7–30. Figure 7–32 is the schematic diagram, and figure 7–31 is the voltage and resistance diagram.

7–85. REMOVAL AND REPLACEMENT. Paragraph 7–53 describes the procedures required to remove this subassembly from the channelizer subassembly. After performing these removal procedures, and if required, further disassembly of the unit will be evident to the technician. When performing any disassembly which requires unsoldering of wires, always tag the wires so

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
1	J3407	Frequency Meter AN/USM-26	Function control on Radio Set Control CPC-1 set to "AME" position and "CHANNEL" select switches set to "BKBB."	200.0 kc ± 3 cps	1a. If no output, check all voltages associated with V3601A and compare with those shown in figure 7-31. Check all parts associated with abnormal voltage measurements and replace as required. 1b. If incorrect frequency, check operation of K3601 and K3602. Also check voltage divider resistance. Should be 7948 ohms. Check for negative voltage at CR3603. 1c. If unstable frequency, check oven heater and thermostat.
2	J3407	Same as step 1.	Same as step 1 with "CHANNEL" select switches set to "CGLP."	200.25 kc ± 3 cps	2a. Same as step 1.
3	J3407	Same as step 1.	Same as step 1 with "CHANNEL" select switches set to "DDPD."	200.5 kc ± 3 cps	3a. Same as step 1.
4	J3407	Same as step 1.	Same as step 1 with "CHANNEL" select switches set to "FDSV".	200.75 kc ± 3 cps	4a. Same as step 1.
5	J3408	Same as step 1.	Same as step 1 with "CHANNEL" select switches set to "BKBB".	330 kc ± 3 cps	5a. If no output, check all voltages associated with V3601B and compare with those shown in figure 7-31. Check all parts associated with abnormal voltage measurements and replace as required. 5b. If incorrect frequency, check operation of S3601 and voltage divider resistance. Should be 7948 ohms. Also check for negative voltage at CR3601. 5c. If unstable frequency, check oven heater and thermostat.
6	J3408	Same as step 1.	Repeat step 5 for each of the "CHANNEL" select switch settings in the following list. "CGLP" "DDPD" "CHHS" "FLDG" "FDSV" "CGXJ" "VLWK" "SJZL" "FLZZ"	 331 kc ± 3 cps 332 kc ± 3 cps 333 kc ± 3 cps 334 kc ± 3 cps 335 kc ± 3 cps 336 kc ± 3 cps 337 kc ± 3 cps 338 kc ± 3 cps 339 kc ± 3 cps	6a. Same as steps 5a through 5c.

Figure 7-30. Dual Crystal Oscillator Subassembly, Trouble Analysis Chart



NOTES:

1. AC AND DC READINGS MADE WITH VTVM.
2. RESISTANCE MEASUREMENTS MADE WITH 20,000 OHM-PER-VOLT METER.
3. EQUIPMENT TUNED TO 2.0 MC (BKBB).
4. ALL MEASUREMENTS MADE WITH RESPECT TO GROUND.
5. AC MEASUREMENTS IN PARENTHESIS.

Figure 7–31. Dual Crystal Oscillator Subassembly Tube Voltage and Resistance Diagram

that exact replacement is accomplished. Also, if ever it is necessary to replace S3601, make certain it is oriented both as to shaft position and contact position as the replaced wafer.

7–86. ALINEMENT AND ADJUSTMENT. This subassembly is adjusted at the factory to produce the nominal crystal frequencies and, unless it is necessary to replace a crystal or any of the varicap diodes (CR3601 through CR3604), no adjustment or alinement should be attempted. In the event a varicap diode must be replaced due to a failure, all output frequencies associated with the respective tube section must be checked as outlined in figure 7–30. Where any output frequency is outside the indicated tolerance, the respective bias tap on the voltage divider (R3625 through R3648) must be changed to bring the output frequency within tolerance. If it is necessary to replace any of the crystals (Y3601 through Y3614) the replacement crystal must be as close to the nominal frequency as possible (preferably on the high side of the frequency). The output frequency for the replaced crystal must then be checked and where necessary, the tap from the crystal to the voltage divider must be changed to bring the output frequency into tolerance. All frequency checks, test equipment connections, and control setting instructions to perform these adjustments are outlined in figure 7–30.

7–87. DETAILED CIRCUIT ANALYSIS. The dual crystal oscillator subassembly is a part of the controlled master oscillator assembly. It provides ten crystal controlled frequencies in one-kilocycle steps within the range of 330 to 339 kilocycles from the B oscillator and four crystal controlled frequencies from the A oscillator in 250-cycle steps within the range of 200 to 200.75 kilocycles. The output frequencies from both oscillator stages are used in this equipment to control the selection of the units and fractions of units of the desired output frequency of the receiver-transmitter. Figure 7–32 shows that any one of ten crystals (Y3605 through Y3614) is selected by means of the motor driven switch S3601 to control the frequency of oscillation of V3601B. The selected crystal is coupled through capacitor C3603 to the control grid of V3601B. The output of the oscillator is connected from the cathode of V3601B through a coaxial connector to pin 15 of J3301 on the channelizer chassis where it is connected to the respective mixer in the discriminator subassembly (see paragraph 7–102). Fine control of the frequency of oscillation of the stage is afforded by use of the varicap diodes CR3601 and CR3602. As noted in figure 7–32, these diodes are shunted across the oscillator control elements and the necessary shunt capacitance determined by means of selecting the proper biasing voltage from the voltage divider consisting of resistors R3625 through

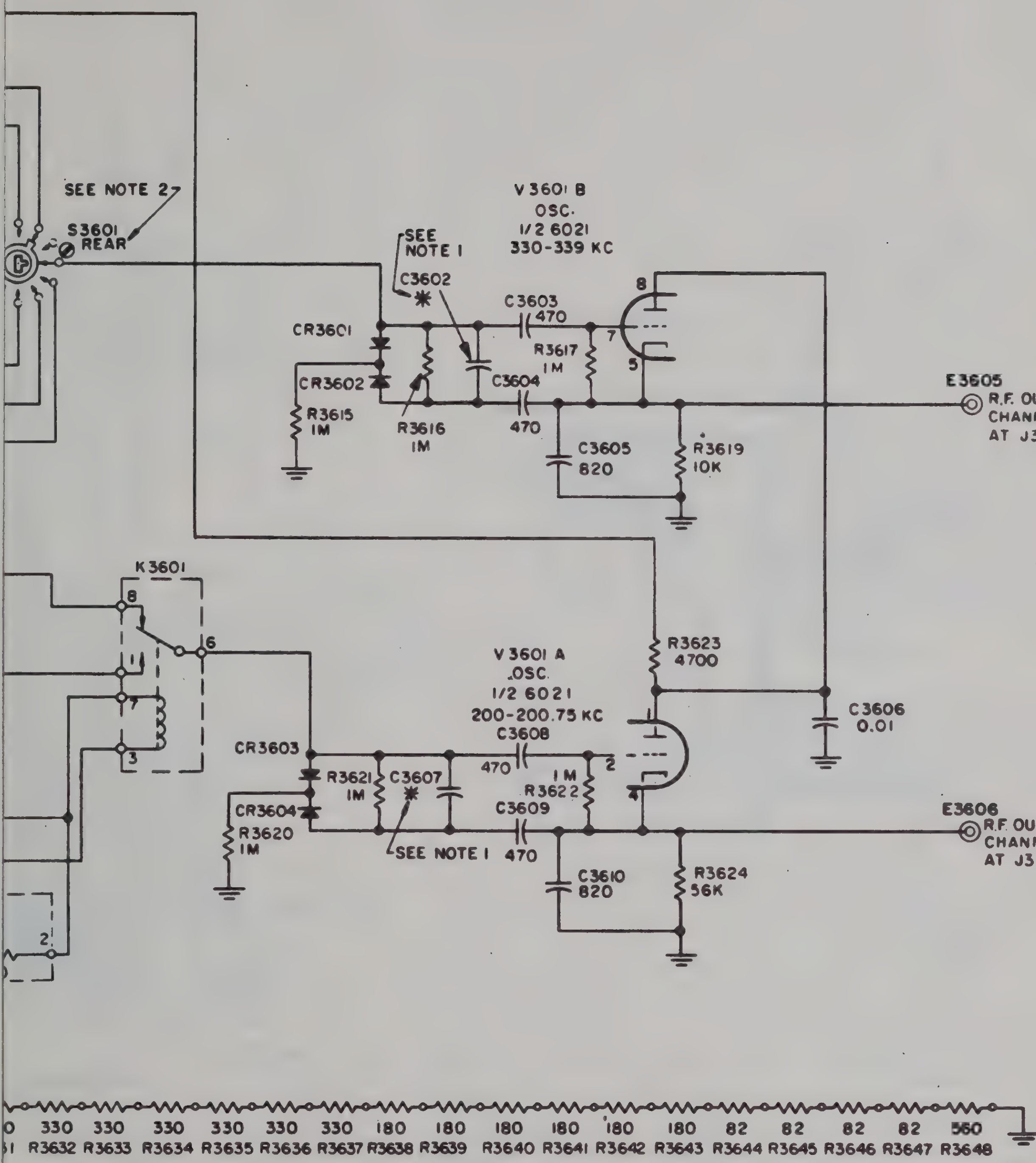
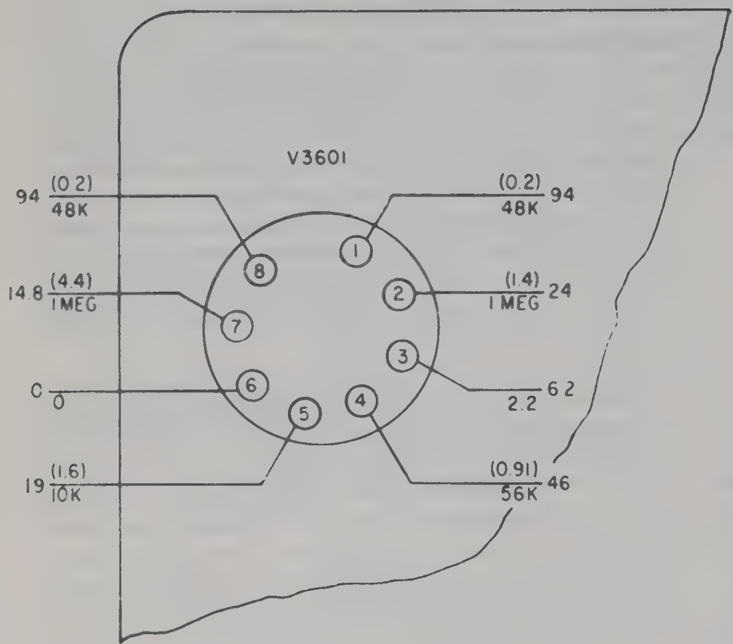


Figure 7–32. Dual Crystal Oscillator Subassembly, Schematic Diagram



NOTES:

1. AC AND DC READINGS MADE WITH VTVM.
2. RESISTANCE MEASUREMENTS MADE WITH 20,000 OHM-PER-VOLT METER.
3. EQUIPMENT TUNED TO 2.0 MC (BKBB).
4. ALL MEASUREMENTS MADE WITH RESPECT TO GROUND.
5. AC MEASUREMENTS IN PARENTHESIS.

Figure 7–31. Dual Crystal Oscillator Subassembly Tube Voltage and Resistance Diagram

that exact replacement is accomplished. Also, if ever it is necessary to replace S3601, make certain it is oriented both as to shaft position and contact position as the replaced wafer.

7–86. ALINEMENT AND ADJUSTMENT. This subassembly is adjusted at the factory to produce the nominal crystal frequencies and, unless it is necessary to replace a crystal or any of the varicap diodes (CR3601 through CR3604), no adjustment or alinement should be attempted. In the event a varicap diode must be replaced due to a failure, all output frequencies associated with the respective tube section must be checked as outlined in figure 7–30. Where any output frequency is outside the indicated tolerance, the respective bias tap on the voltage divider (R3625 through R3648) must be changed to bring the output frequency within tolerance. If it is necessary to replace any of the crystals (Y3601 through Y3614) the replacement crystal must be as close to the nominal frequency as possible (preferably on the high side of the frequency). The output frequency for the replaced crystal must then be checked and where necessary, the tap from the crystal to the voltage divider must be changed to bring the output frequency into tolerance. All frequency checks, test equipment connections, and control setting instructions to perform these adjustments are outlined in figure 7–30.

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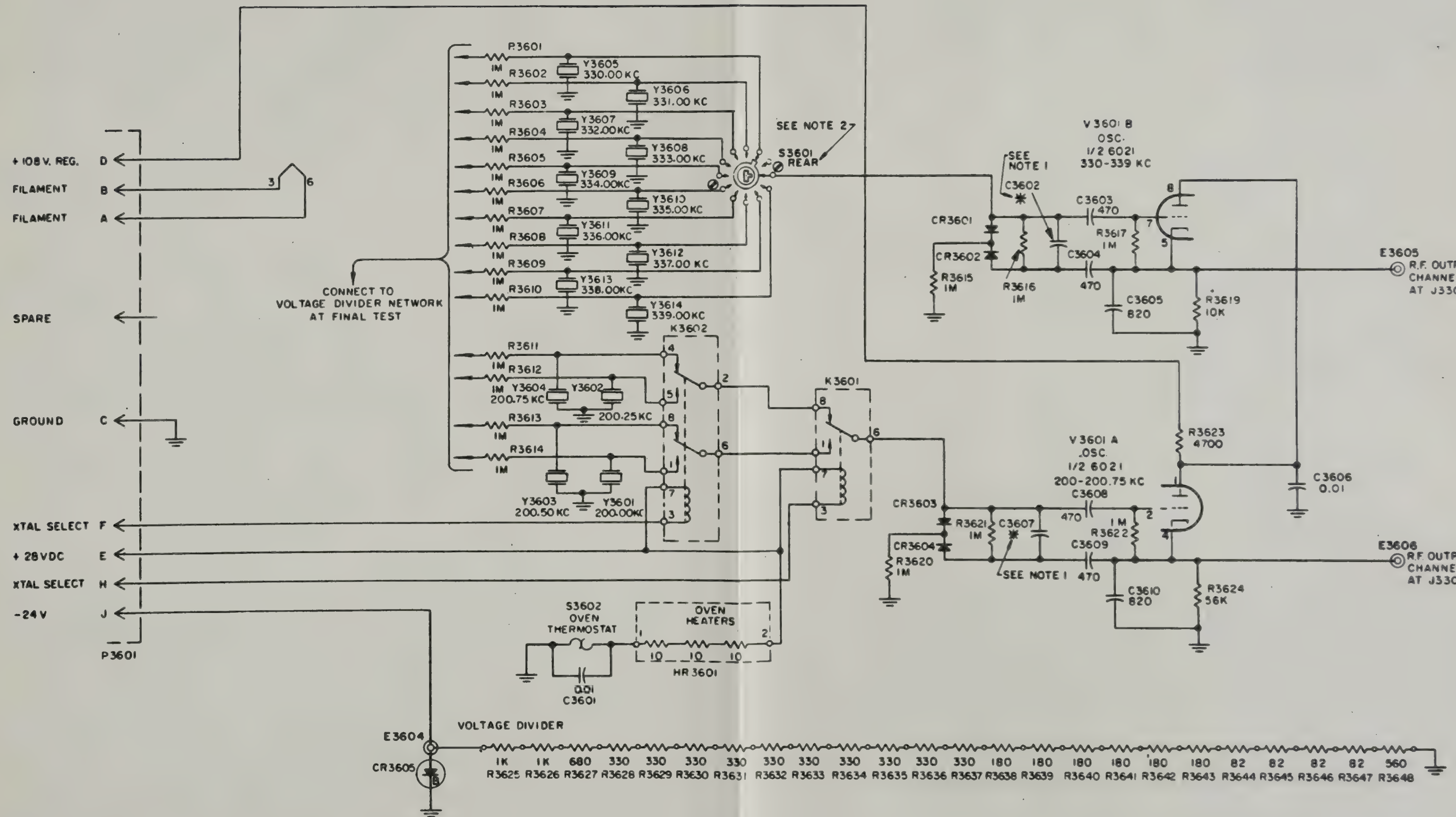
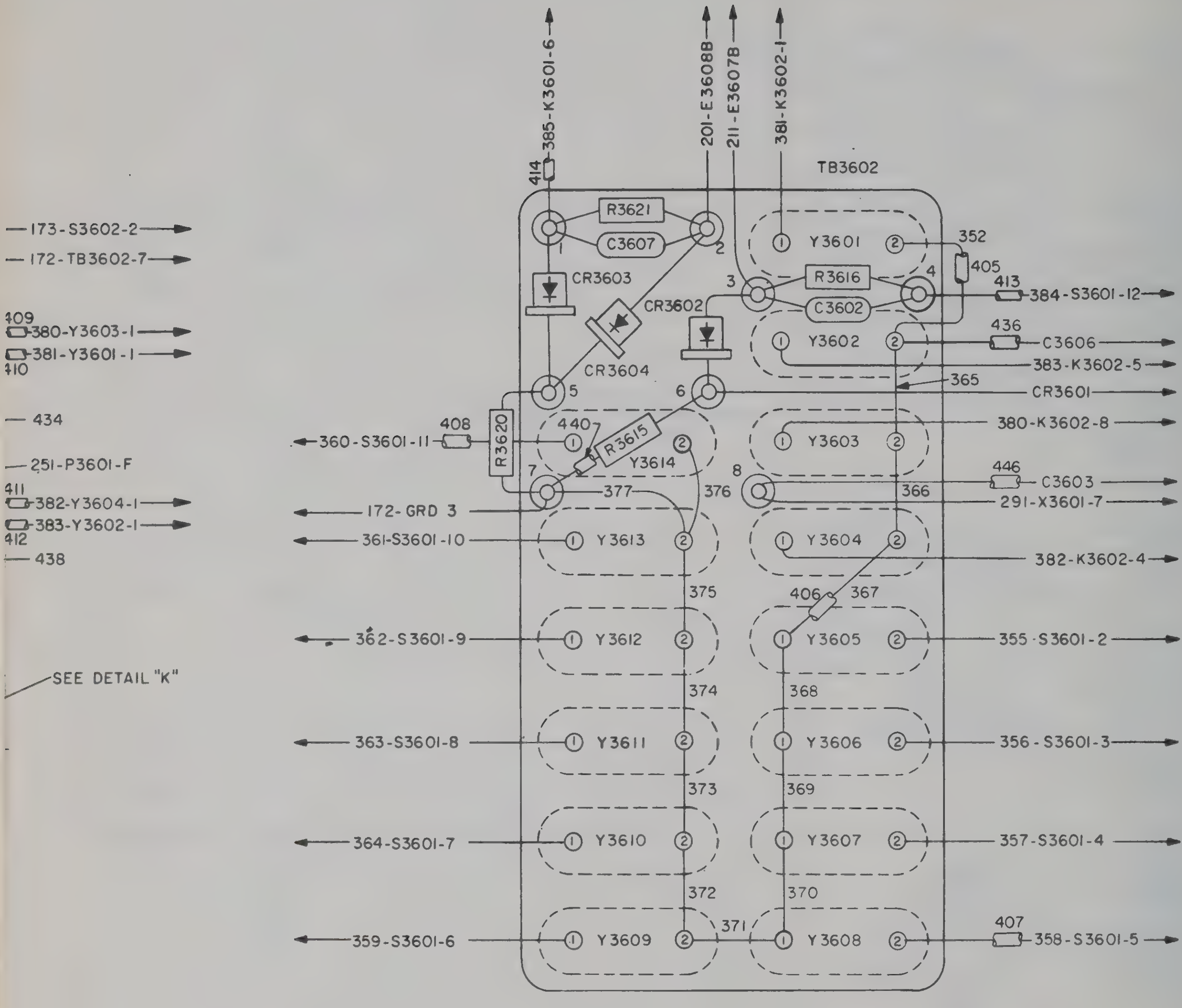


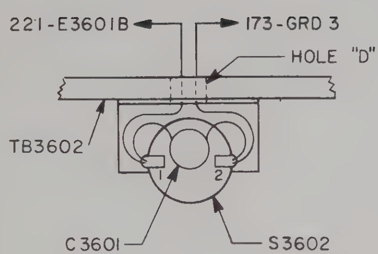
NOTES
1. ✱ VALUE OF 4 TO 12 PF TO BE DETERMINED AT TEST IN 1PF INCREMENTS
2. VIEWED FROM CRYSTAL BOARD SIDE.

Figure 7–32. Dual Crystal Oscillator Subassembly, Schematic Diagram

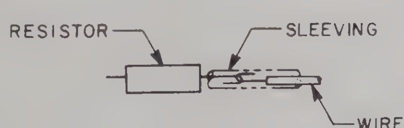


DETAIL "C"

Figure 7–33. Dual Crystal Oscillator Subassembly Wiring Diagram (Sheet 1 of 2)



DETAIL "J"



DETAIL "K"

421-446	SLEEVING INSULATED TEFLON .031 DIA
401-408	SLEEVING INSULATED TEFLON .021 DIA
351-385	WIRE TINNED COPPER .015 DIA
321	WIRE-WHT-GRN/BLU TCR 7/.008 600V
311	GRN/YEL
301	GRN/RED
291	YEL/BLK
281	YEL/GRN
271	YEL/RED
261	ORN/GRN
251	RED/YEL
241	BRN/BLU
231	BRN/GRN
221	VIO/RED
211	VIO/ORN
201	VIO/BRN
191	VIO/BLK
181-182	VIO/YEL TCR
171-173	BLK TCR
161	WHT-BRN TCR
151	BRN 7/.008
141	WHT-BLU/GRN TCR 7/.005
131	BLU/RED
121	BLU/ORN
111	GRN/VIO
101	GRN/YEL
91	GRN/BLK
81	YEL/BLU
71	YEL/ORN
61	ORN/RED
51	ORN/BLK
41	RED/BLU
31	RED/GRN
21	BRN/YEL
11	BRN/ORN TCR
1-2	WIRE-WHT-YEL TCR 7/.005 600V
WIRE Nos (INCL)	COLOR AND CONDUCTOR DESCRIPTION
WIRE TABLE	

Figure 7–33. Dual Crystal Oscillator Subassembly Wiring Diagram (Sheet 2 of 2)

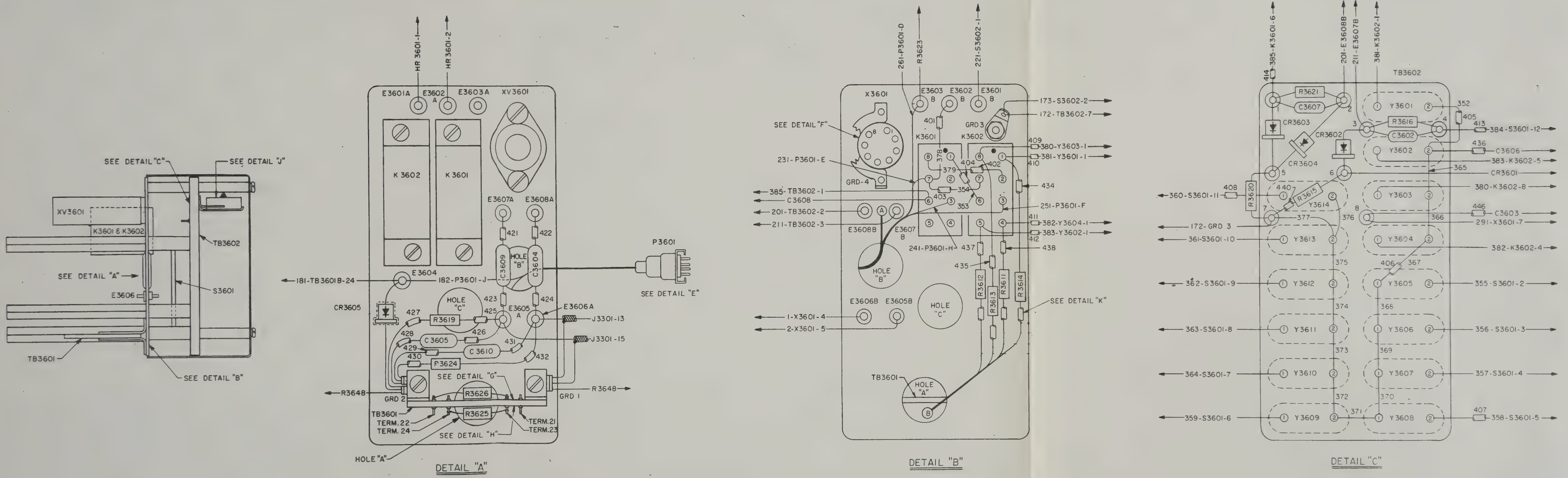
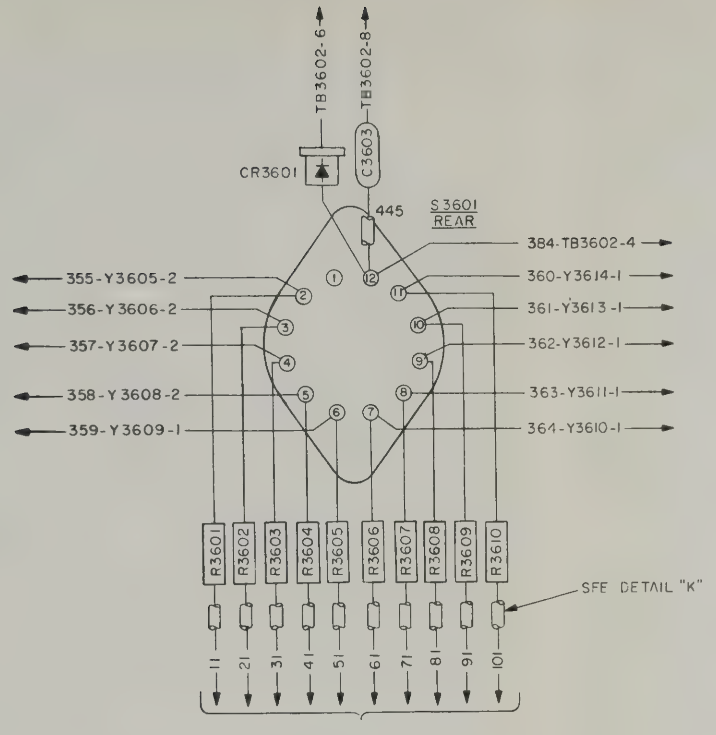
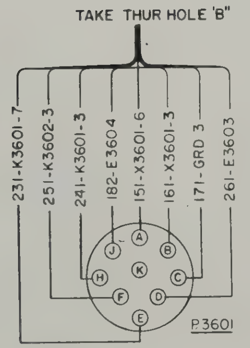


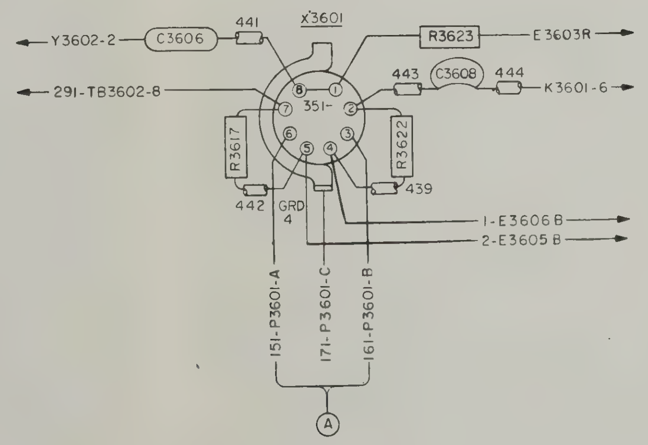
Figure 7–33. Dual Crystal Oscillator Subassembly Wiring Diagram (Sheet 1 of 2)



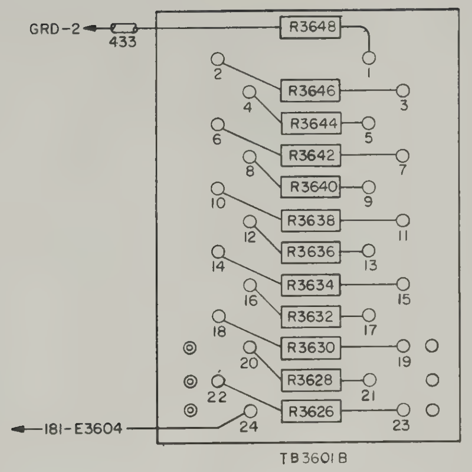
DETAIL "D"



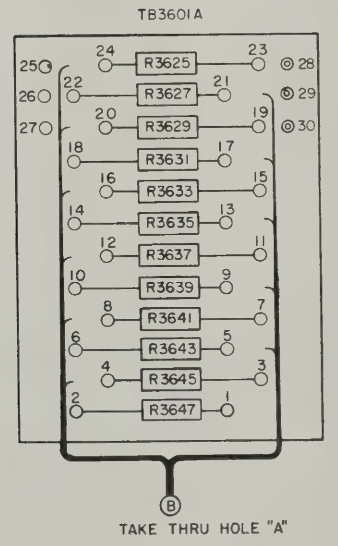
DETAIL "E"



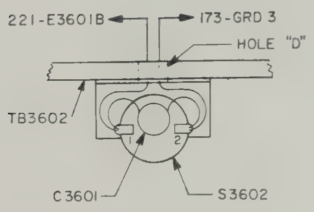
DETAIL "F"



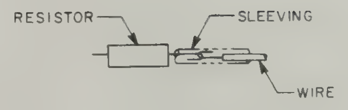
DETAIL "G"



DETAIL "H"



DETAIL "J"



DETAIL "K"

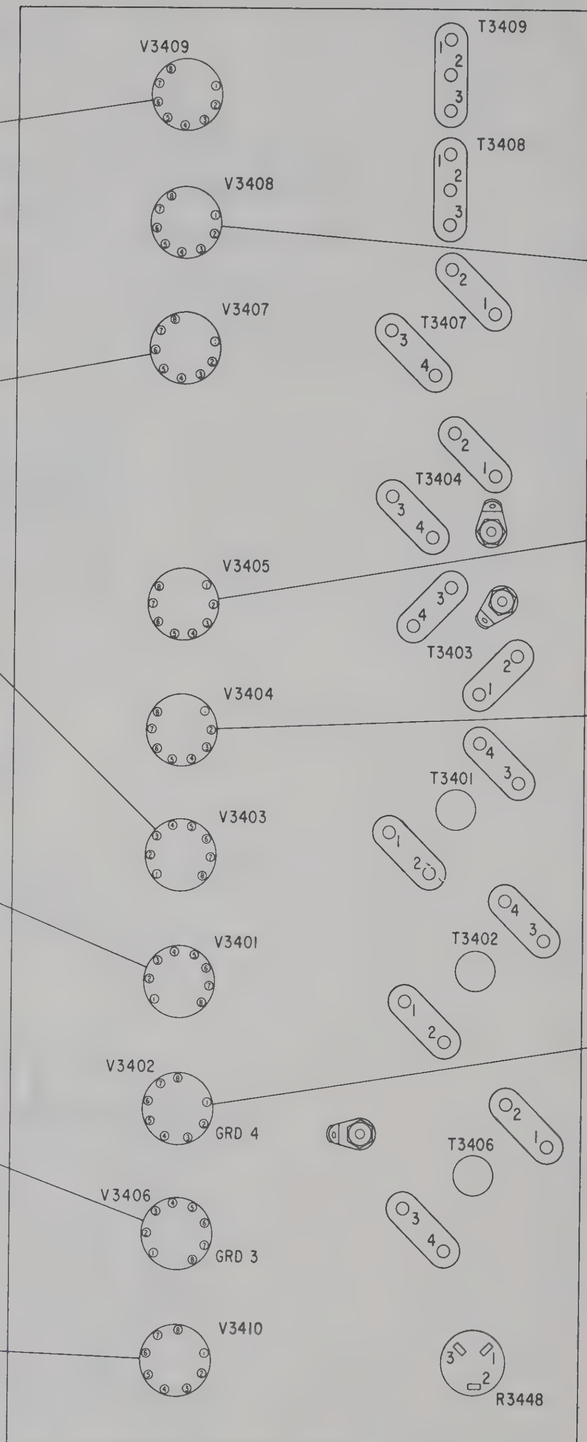
WIRE Nos (INCL)	COLOR AND CONDUCTOR DESCRIPTION
421-446	SLEEVING INSULATED TEFLON .031 DIA
401-408	SLEEVING INSULATED TEFLON .021 DIA
351-385	WIRE TINNED COPPER .015 DIA
321	WIRE-WHT-GRN/BLU TCR 7/.008 600V
311	GRN/YEL
301	GRN/RED
291	YEL/BLK
281	YEL/GRN
271	YEL/RED
261	ORN/GRN
251	RED/YEL
241	BRN/BLU
231	BRN/GRN
221	VIO/RED
211	VIO/ORN
201	VIO/BRN
191	VIO/BLK
181-182	VIO/YEL TCR
171-173	BLK TCR
161	WHT-BRN TCR
151	BRN 7/.008
141	WHT-BLU/GRN TCR 7/.005
131	BLU/RED
121	BLU/ORN
111	GRN/VIO
101	GRN/YEL
91	GRN/BLK
81	YEL/BLU
71	YEL/ORN
61	ORN/RED
51	ORN/BLK
41	RED/BLU
31	RED/GRN
21	BRN/YEL
11	BRN/ORN TCR
1-2	WIRE-WHT-YEL TCR 7/.005 600V

WIRE TABLE

Figure 7–33. Dual Crystal Oscillator Subassembly Wiring Diagram (Sheet 2 of 2)

MODE	IN LOCK		OUT OF LOCK		RES. (OHMS)
TUBE	VOLTAGE		VOLTAGE		
PIN	DC	AC	DC	AC	
1	70	39	70	39	77K
2	-14	10.7	-14	10.7	90K
3	25	0	25	0	3.2
4	0	0	0	0	0
5	6.8	9.6	6.6	9.6	12K
6	18.3	0	18.3	0	3.2
7	-32.5	39	-33	39	900K
8	45	3	45	3	140K

MODE	IN LOCK		OUT OF LOCK		RES. (OHMS)
TUBE	VOLTAGE		VOLTAGE		
PIN	DC	AC	DC	AC	
1	98	67	98	67	50K
2	-15	12.5	-15	12.5	480K
3	12.1	0	12.1	0	2.4
4	0	0	0	0	0
5	0	0	0	0	INF.
6	18.9	0	18.9	0	3.2
7	0	0	0	0	INF.
8	0	0	0	0	INF.



1	58	40	58	40	78K
2	-5.2	4.6	-5.2	4.6	95K
3	6.2	0	6.2	0	1.5
4	0	0	0	0	0
5	6.3	10.2	6.3	10	5.6K
6	12.4	0	12.4	0	2.4
7	-33	39	-33	39	1MEG.
8	80	0.7	80	0.66	65K

1	93	7.0	103	2.9	55K
2	0	33	0	10	1MEG.
3	0	0	0	0	0
4	10.2	16.3	4.7	9.3	10K
5	5.7	0	1.5	0	15K
6	6.1	0	6.1	0	1.3
7	2.95	0	-1.4	0	1MEG.
8	103	0	108	0	53K

1	-43	35	-5.2	5.5	1MEG.
2	1.6	0	1.8	0	820
3	24.5	0	24.5	0	3.2
4	0	9.8	0	0.13	0.1
5	98	50	99	16	48K
6	18.2	0	18.2	0	2.3
7	98	0	100	0	48K
8	1.6	0	1.8	0	820

1	-36	29.3	-7.8	6.4	1MEG.
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	96	52	100	11	53K
6	6.1	0	6.1	0	1.4
7	38	0.1	54	1.1	220K
8	0	0	0	0	0

1	-4.3	1.1	-3.75	0	6.5K
2	0	0	0	0	0
3	18.5	0	18.5	0	2.9
4	0	0	0	0	0
5	98	9.1	98	0	48K
6	12.2	0	12.2	0	2.1
7	100	0	100	0	48K
8	0	0	0	0	0

1	-4.5	6.0	-3.75	0	6.5K
2	2.8	0.18	1.1	0	820
3	6	0	6	0	1.4
4	0	1.55	0	1.55	3.4
5	104	9.8	107	0.26	45K
6	12	0	12	0	2.3
7	62	0	97	0	62K
8	2.8	0.18	1.1	0	820

1	0	1.1	0	1.1	105K
2	2.3	0.14	2.2	0.14	820
3	6.2	0	6.2	0	1.3
4	0	1.83	0	1.83	100K
5	98	15.7	93	16.2	47K
6	0	0	0	0	0
7	71	0.14	68	0.14	62K
8	2.3	0.14	2.2	0.14	820

1	6.2	0	1.6	0	56K
2	8.2	0	6.4	0	820
3	6.0	0	6.0	0	1.5
4	92	0	6.4	0	820
5	85	0	105	0	50K
6	12	0	12	0	2.5
7	85	0	105	0	50K
8	8.2	0	6.4	0	820

NOTES:

1. EQUIPMENT IS IN LOCK WHEN CMO IS RESONANT AT SELECTED FREQUENCY. EQUIPMENT IS OUT OF LOCK WHEN ALL CLUTCHES HAVE CEASED TO ROTATE BUT CMO IS NOT AT RESONANCE. THIS CONDITION CAN BE SIMULATED BY GROUNDING "J3412" TO STOP MOTOR ROTATION AFTER CLUTCHES CEASE TO TURN.
2. ALL READINGS WITH RESPECT TO GROUND.
3. EQUIPMENT TUNED TO 2.0 MC (BKBB) AND NOT KEYED.
4. AC AND DC READINGS MADE WITH VTVM.
5. RESISTANCE READING MADE WITH 20,000 OHM-PER-VOLT METER.

Figure 7–34. Discriminator Subassembly Tube Voltage and Resistance Diagram

R3648. Biasing voltage from the voltage divider is applied through the respective one-megohm resistor and the switch contacts of S3601 to diode CR3601. Diode CR3602 obtains its bias through R3616 and the ground return for both diodes is through R3615. Selection of the individual tap on the voltage divider for the respective crystal is performed during final test at the factory and should not be attempted in the field. Diode CR3605 provides voltage regulation for the —24 volts dc connected across the voltage divider.

7–88. Oscillator A (V3601A) is connected in a similar circuit configuration with the four crystals Y3601 through Y3604 controlling the frequency of operation. Relay K3601 is used to select either one of the two outputs of relay K3602. The latter relay contacts connect crystals Y3603 and Y3604 to the contacts of relay K3601 when K3602 is deenergized, and crystals Y3601 and Y3602 to the contacts of K3601 when energized. Ground for operation of the two relays is provided by the selector switches in the Radio Set Control CPC–1.

7–89. All of the crystals are contained in a removable cover which acts as a temperature compensating oven. The temperature within the enclosure is controlled by means of heater HR3601 and operation of thermostat S3602.

7–90. DISCRIMINATOR SUBASSEMBLY.

7–91. GENERAL DATA. Reference must be made to paragraph 7–40 for a functional description of this subassembly. As this unit is an integral part of the low-level tuning control circuits and therefore, the channelizer subassembly, it must be checked as a part of the latter as outlined in paragraphs 7–46 and 7–47. As no lubrication is required in this subassembly, the lubrication paragraph has been omitted.

7–92. MINIMUM PERFORMANCE STANDARDS. The discriminator subassembly is to be checked as a part of the channelizer subassembly as described in paragraphs 7–46 and 7–47. This check should always be made after a repair, or replacement has been made.

7–93. CHECK-OUT OR ANALYSIS. A defective part in this subassembly could be the cause of incorrect frequency selection. Where these symptoms occur, check as outlined in paragraph 7–46 and 7–47. If a defect is indicated, check in accordance with steps 1, 2, 4, 5, 6, 10, 13, 14, 15, 16, 17, 18, 19, 20, 21, and 22 of figure 7–16 and steps 1, 2, 8, 9, and 10 of figure 7–17. Figure 7–37 is the schematic diagram, figure 7–35 show test point and adjustment locations, and figure 7–34 is the tube socket voltage and resistance diagram.

7–94. REMOVAL AND REPLACEMENT. Paragraph 7–52 describes the removal procedures to be performed in order to remove the discriminator subassembly from the channelizer subassembly. Paragraph 7–54 describes the procedures to be performed in order to gain access to the tube socket pins and other wiring in the subassembly. Further disassembly that may be required in order to make a repair or replacement will be evident to the technician. When performing any disassembly which requires unsoldering of wires, always tag the wires so exact replacement is accomplished.

7–95. ALINEMENT AND ADJUSTMENT. This subassembly is adjusted at the factory for correct operation and alinement or adjustment should never be performed unless a repair or replacement is made which

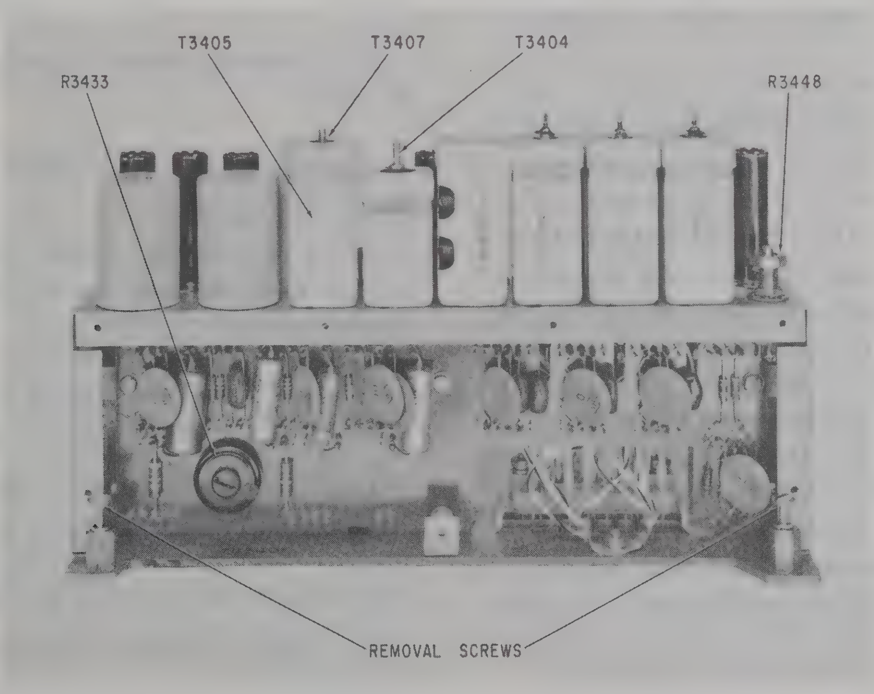


Figure 7–35. Discriminator Subassembly, Left Side View, Adjustment Locations

MODE / TUBE / PIN	IN LOCK VOLTAGE DC	IN LOCK VOLTAGE AC	OUT OF LOCK VOLTAGE DC	OUT OF LOCK VOLTAGE AC	RES (OHMS)
1	70	39	70	39	77K
2	-14	10.7	-14	10.7	90K
3	25	0	25	0	3.2
4	0	0	0	0	0
5	6.8	96	66	9.6	12K
6	183	0	18.3	0	32
7	-325	39	-33	39	900K
8	45	3	45	3	140K

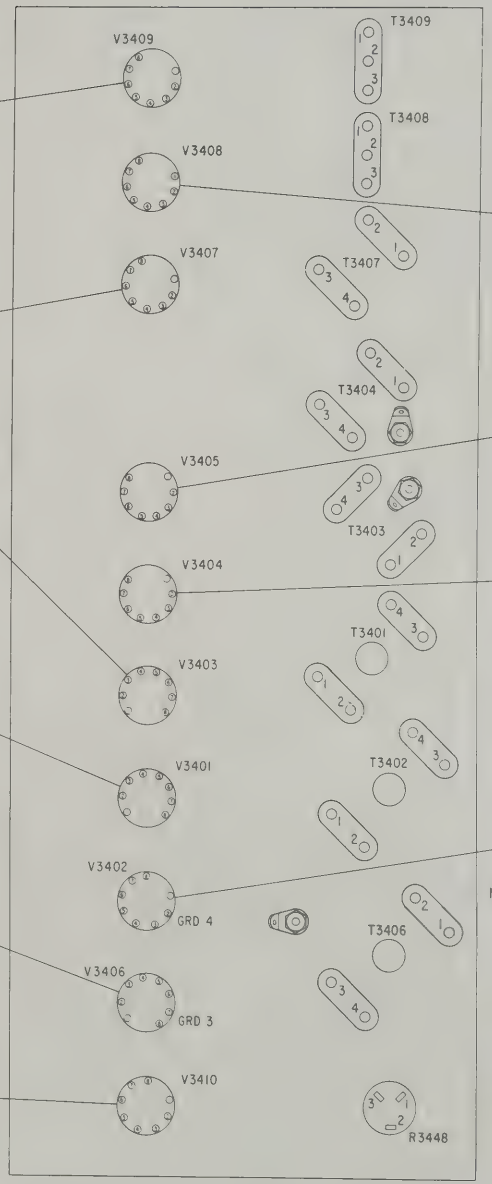
1	58	40	58	40	78K
2	-52	46	-52	46	95K
3	62	0	62	0	15
4	0	0	0	0	0
5	63	102	63	10	56K
6	124	0	124	0	24
7	-33	39	-33	39	IMEG.
8	80	0.7	80	066	65K

1	-43	35	-52	55	IMEG
2	16	0	18	0	820
3	24.5	0	245	0	32
4	0	98	0	0.13	01
5	98	50	99	16	48K
6	182	0	182	0	23
7	98	0	100	0	48K
8	16	0	18	0	820

1	-43	11	-375	0	65K
2	0	0	0	0	0
3	185	0	185	0	29
4	0	0	0	0	0
5	98	91	98	0	48K
6	122	0	122	0	21
7	100	0	100	0	48K
8	0	0	0	0	0

1	0	11	0	11	105K
2	23	014	22	014	820
3	62	0	62	0	13
4	0	183	0	183	100K
5	98	157	93	162	47K
6	0	0	0	0	0
7	71	014	68	0.14	62K
8	23	014	22	0.14	820

1	62	0	16	0	56K
2	82	0	64	0	820
3	60	0	60	0	15
4	92	0	64	0	820
5	85	0	105	0	50K
6	12	0	12	0	25
7	85	0	105	0	50K
8	82	0	64	0	820



MODE / TUBE / PIN	IN LOCK VOLTAGE DC	IN LOCK VOLTAGE AC	OUT OF LOCK VOLTAGE DC	OUT OF LOCK VOLTAGE AC	RES (OHMS)
1	98	67	98	67	50K
2	-15	125	-15	125	480K
3	12.1	.0	121	0	24
4	0	0	0	0	0
5	0	0	0	0	INF
6	189	0	189	0	32
7	0	0	0	0	INF
8	0	0	0	0	INF

1	93	70	103	29	55K
2	0	33	0	10	IMEG
3	0	0	0	0	0
4	10.2	16.3	4.7	93	10K
5	5.7	0	1.5	0	15K
6	6.1	0	6.1	0	13
7	2.95	0	-14	0	IMEG
8	103	0	108	0	53K

1	-36	293	-78	64	IMEG
2	0	0	0	0	0
3	0	0	0	0	0
4	0	0	0	0	0
5	96	52	100	11	53K
6	61	0	61	0	14
7	38	01	54	11	220K
8	0	0	0	0	0

1	-45	60	-375	0	65K
2	28	018	11	0	820
3	6	0	6	0	14
4	0	155	0	155	34
5	104	98	107	026	45K
6	12	0	12	0	23
7	62	0	97	0	62K
8	28	018	11	0	820

NOTES:

1. EQUIPMENT IS IN LOCK WHEN CMO IS RESONANT AT SELECTED FREQUENCY. EQUIPMENT IS OUT OF LOCK WHEN ALL CLUTCHES HAVE CEASED TO ROTATE BUT CMO IS NOT AT RESONANCE. THIS CONDITION CAN BE SIMULATED BY GROUNDING "J3412" TO STOP MOTOR ROTATION AFTER CLUTCHES CEASE TO TURN
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3. EQUIPMENT TUNED TO 2.0 MC (BKBB) AND NOT KEYED.
4. AC AND DC READINGS MADE WITH VTVM.
5. RESISTANCE READING MADE WITH 20,000 OHM-PER-VOLT METER.

Figure 7–34. Discriminator Subassembly Tube Voltage and Resistance Diagram

R3648. Biasing voltage from the voltage divider is applied through the respective one-megohm resistor and the switch contacts of S3601 to diode CR3601. Diode CR3602 obtains its bias through R3616 and the ground return for both diodes is through R3615. Selection of the individual tap on the voltage divider for the respective crystal is performed during final test at the factory and should not be attempted in the field. Diode CR3605 provides voltage regulation for the —24 volts dc connected across the voltage divider.

7-88. Oscillator A (V3601A) is connected in a similar circuit configuration with the four crystals Y3601 through Y3604 controlling the frequency of operation. Relay K3601 is used to select either one of the two outputs of relay K3602. The latter relay contacts connect crystals Y3603 and Y3604 to the contacts of relay K3601 when K3602 is deenergized, and crystals Y3601 and Y3602 to the contacts of K3601 when energized. Ground for operation of the two relays is provided by the selector switches in the Radio Set Control CPC-1.

7-89. All of the crystals are contained in a removable cover which acts as a temperature compensating oven. The temperature within the enclosure is controlled by means of heater HR3601 and operation of thermostat S3602.

7-90. DISCRIMINATOR SUBASSEMBLY.

7-91. GENERAL DATA. Reference must be made to paragraph 7-40 for a functional description of this subassembly. As this unit is an integral part of the low-level tuning control circuits and therefore, the channelizer subassembly, it must be checked as a part of the latter as outlined in paragraphs 7-46 and 7-47. As no lubrication is required in this subassembly, the lubrication paragraph has been omitted.

7-92. MINIMUM PERFORMANCE STANDARDS. The discriminator subassembly is to be checked as a part of the channelizer subassembly as described in paragraphs 7-46 and 7-47. This check should always be made after a repair, or replacement has been made.

7-93. CHECK-OUT OR ANALYSIS. A defective part in this subassembly could be the cause of incorrect frequency selection. Where these symptoms occur, check as outlined in paragraph 7-46 and 7-47. If a defect is indicated, check in accordance with steps 1, 2, 4, 5, 6, 10, 13, 14, 15, 16, 17, 18, 19, 20, 21, and 22 of figure 7-16 and steps 1, 2, 8, 9, and 10 of figure 7-17. Figure 7-37 is the schematic diagram, figure 7-35 show test point and adjustment locations, and figure 7-34 is the tube socket voltage and resistance diagram.

7-94. REMOVAL AND REPLACEMENT. Paragraph 7-52 describes the removal procedures to be performed in order to remove the discriminator subassembly from the channelizer subassembly. Paragraph 7-54 describes the procedures to be performed in order to gain access to the tube socket pins and other wiring in the subassembly. Further disassembly that may be required in order to make a repair or replacement will be evident to the technician. When performing any disassembly which requires unsoldering of wires, always tag the wires so exact replacement is accomplished.

7-95. ALINEMENT AND ADJUSTMENT. This subassembly is adjusted at the factory for correct operation and alinement or adjustment should never be performed unless a repair or replacement is made which

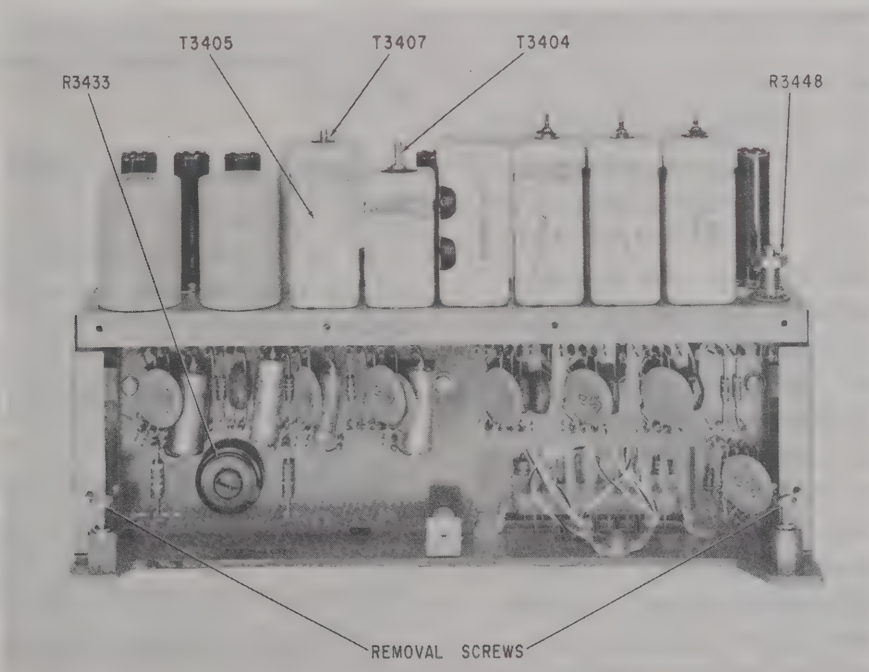


Figure 7-35. Discriminator Subassembly, Left Side View, Adjustment Locations

would upset the alinement of the repaired circuit. Replacement transformers and filters are prealined at the factory and therefore, only touch-up alinement will be required. Never attempt an alinement or adjustment if the subassembly performs within the tolerances indicated in paragraphs 7-46 and 7-47. The alinement and adjustment procedures that follow must be made with the subassembly removed from the channelizer subassembly. An extension cable will be required to interconnect this subassembly with the channelizer subassembly in order to obtain operating voltages only. Therefore only pins 8, 5, 12, 14, 16, 17, 18, and 19 of P3401 and J3301 are to be interconnected.

7-95A. Adjustment of R3453:

a. Connect discriminator subassembly to a complete and normally operating channelizer and reference oscillator subassembly by means of a jumper cable with all pins connected.

b. Connect a d.c. voltmeter to J-3401 and adjust R3453 until 4.2 volts d.c. is read on the meter.

c. Connect an a.c. VTVM to J-3403 and J-3404. Adjust R-3453 until the voltages at these points are in accordance with figure 7-14, page 7-18. Proper operation of the set; that is, lock in, will take precedence over the adjustment procedures a. and b. above. If the discriminator will not operate properly after the above adjustment, R-3453 may be adjusted until proper operation is indicated. Pay particular attention to the caution note on page 7-53. If these filters are out of adjustment, the proper adjustment of R-3453 may not result in proper operation of the set. In this case the maladjusted filter should be replaced and the complete set returned as outlined in paragraphs 7-95 through 7-101.

7-96. Adjustment of R3433. This is a screwdriver adjustment and should never be changed from the factory setting unless a replacement is made or as indicated in paragraph 7-100. If it ever is required to replace this control, the replacement control must be set initially for a resistance of 150,000 ohms. This adjustment is to be accomplished after the replacement has been made using a calibrated ohmmeter. The probes of the ohmmeter are to be connected between pin 2 of XV3408 and ground. No power is to be applied to the equipment while performing this adjustment. Further adjustment of R3433 is then accomplished as outlined in paragraph 7-100.

7-97. Adjustment of R3448. This is a screwdriver adjustment and should never be changed from the factory setting unless a replacement is made. Final adjustment of R3448 can only be made with complete and normally operating channelizer and reference oscillator subassemblies. Proceed as follows to adjust R3448.

a. Connect the d-c probe of the vtvm to J3413.

b. Connect vertical input of oscilloscope to J3406.

c. Operate the CHANNEL select switches to TCMM.

d. If necessary, adjust R3448 to achieve a lock-in pattern on the oscilloscope (see figure 7-10).

e. After lock-in, rotate R3448 fully clockwise.

f. While viewing sawtooth pattern on oscilloscope, momentarily touch tip of screwdriver to plates of variable C33021. Notice that this unlocks the sawtooth.

g. While sawtooth is unlocked, slowly adjust R3448 in a counterclockwise direction until motor B3301 begins to run. Unit

should lock in, and vtvm should read between 5 to 8 volts dc.

h. Operate the CHANNEL select switches to CMZZ. After unit has locked in, vtvm should read between 6.5 to 7.25 vdc.

i. If necessary, repeat steps c through h until the vtvm reading of step h is obtained.

7-98. Alinement of T3405. Proceed as follows:

a. Connect signal generator through a 0.1 uf capacitor to "J3404".

b. Connect frequency meter across signal generator output and set for an output frequency of 300 kc as monitored on the frequency meter.

c. Connect vtvm probes between terminal 4 of T3405 and ground and set the signal generator output level to 0.6 volt rms as observed on the vtvm.

d. Adjust core of T3405 to give a maximum reading on the vtvm, reducing the signal generator output as required to maintain the 0.6 volt rms level.

7-99. Alinement of T3404. Proceed as follows:

a. Connect signal generator to "J3403."

b. Connect vtvm probes between "J3404" and ground.

c. Connect 0.1 uf capacitor from pin 4 of T3405 to ground.

d. Set signal generator to an output frequency of 100 kc as monitored with the frequency meter.

e. Adjust core of T3404 for maximum indication on the vtvm.

f. Remove 0.1 uf capacitor from pin 4 of T3405.

g. Connect signal generator to "J3402."

h. Connect vtvm probes between "J3403" and ground.

i. Connect vertical amplifier oscilloscope probe through a 5 uuf capacitor to "J3404".

j. Set signal generator to an output frequency of 1 mc as monitored with the frequency meter.

k. Adjust output level of signal generator until a reading of 4.0 volts rms is indicated on the vtvm.

l. Observe waveform on oscilloscope and rock signal generator tuning dial above and below 1 mc to determine whether locking action of divider-mixer stage is symmetrical as shown in figure 7-36. The range should be at least 990 kc to 1010 kc.

m. Adjust core of T3404 for maximum amplitude on scope when the signal generator is set to 1 mc.

n. Adjust core of T3405 for symmetrical capture range as shown in figure 7-36.

7-100. Alinement of T3407. Proceed as follows:

a. Connect signal generator through a 10 uuf capacitor to pin 2 of P3401.

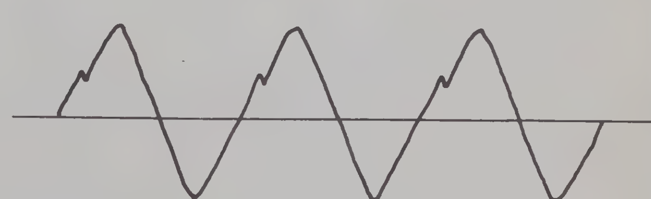
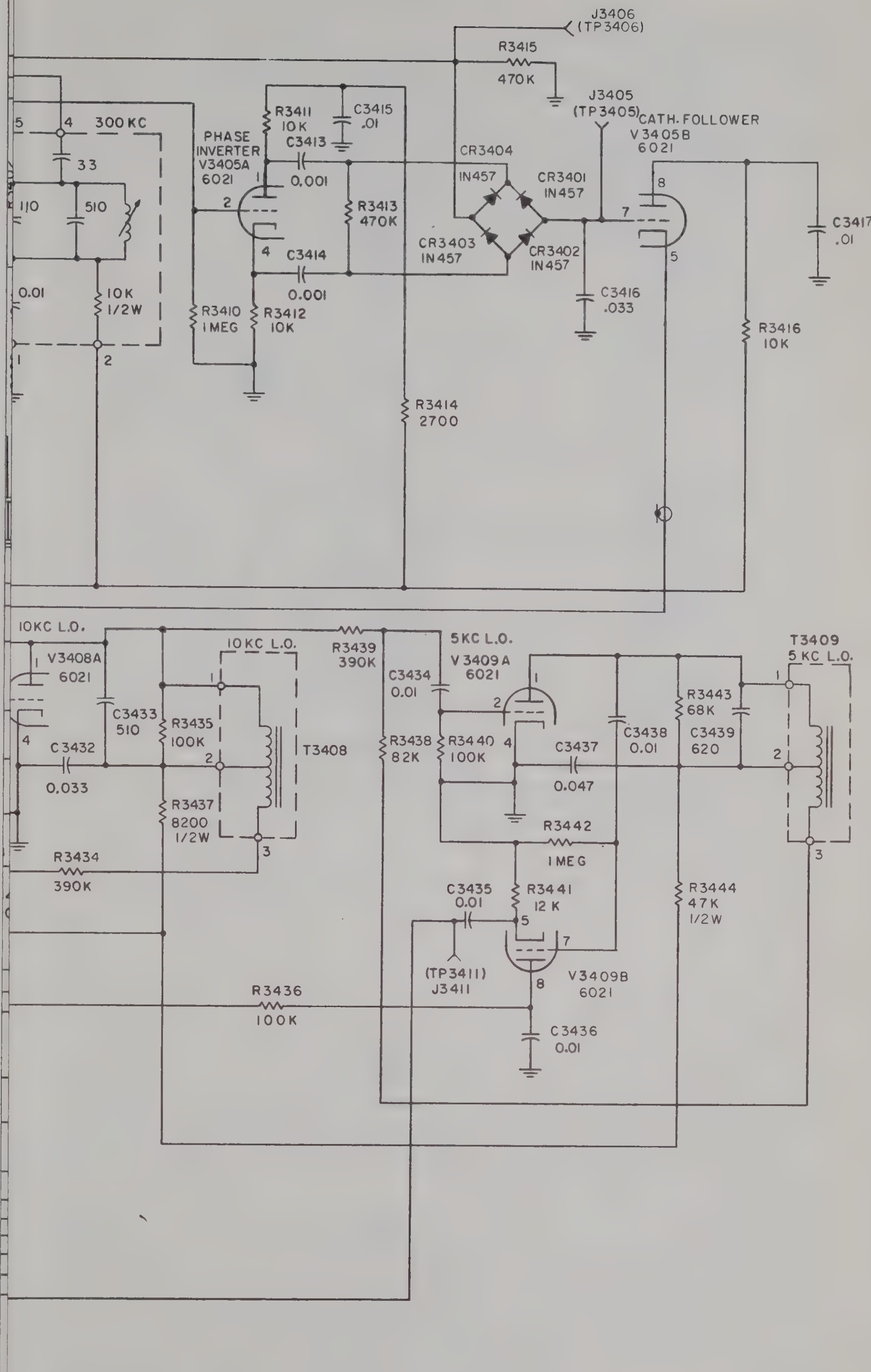
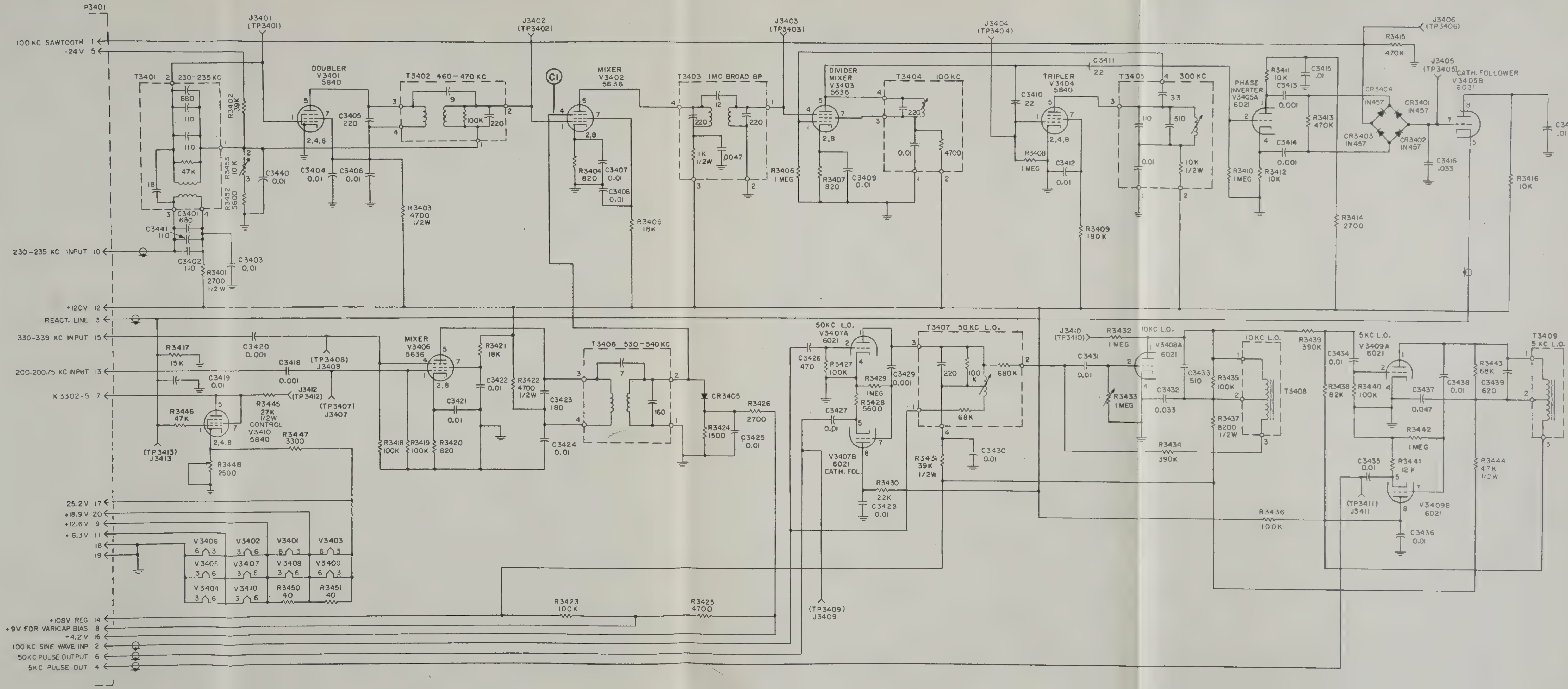


Figure 7-36. Typical Symmetrical Capture Range Pattern



7-37. Discriminator Subassembly, Schematic Diagram



NOTES:
1. ALL RESISTANCE VALUES ARE IN OHMS UNLESS OTHERWISE INDICATED.
2. ALL CAPACITORS ARE IN UF UNLESS OTHERWISE INDICATED.

Figure 7-37. Discriminator Subassembly, Schematic Diagram

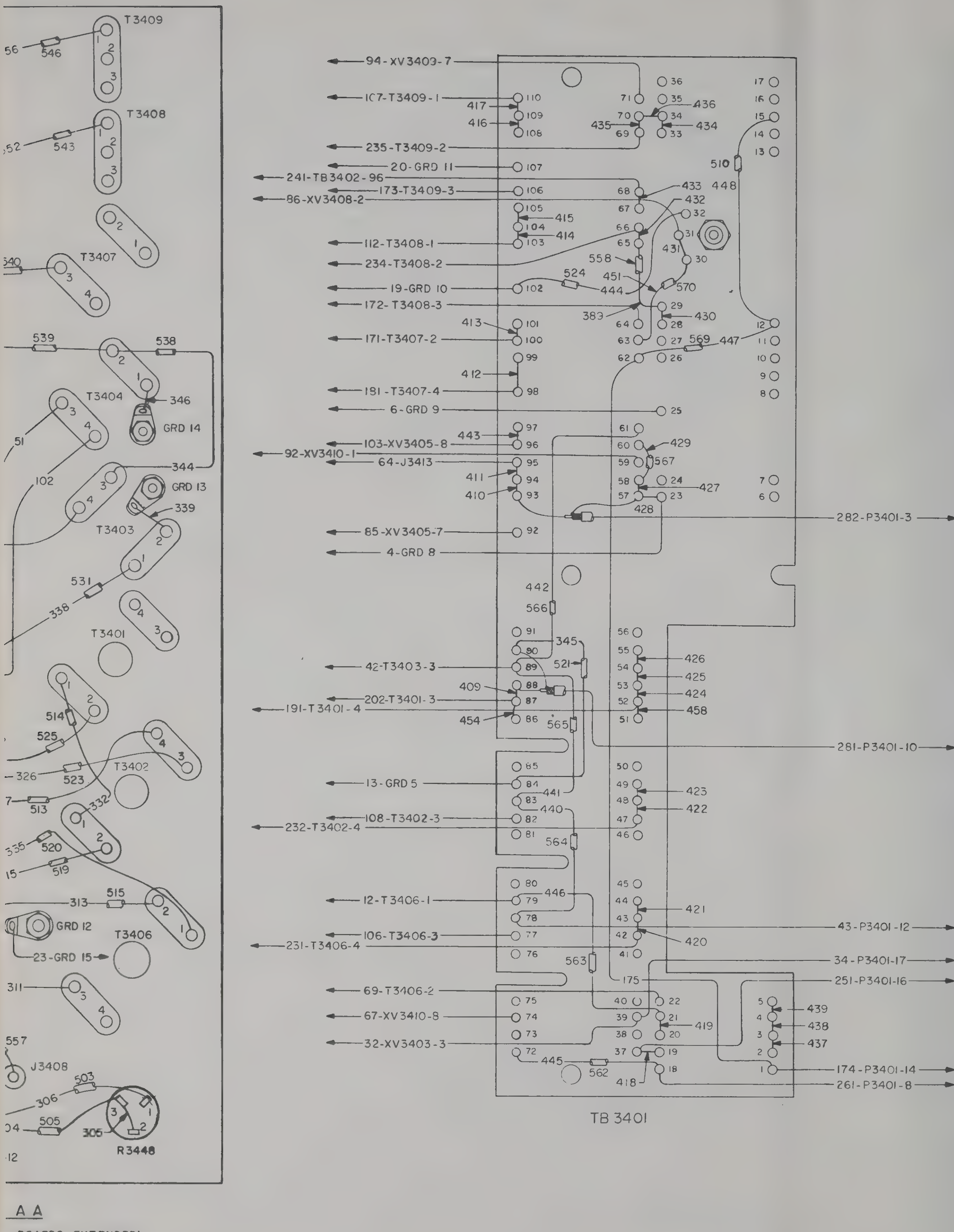


Figure 7–38. Discriminator Subassembly Wiring Diagram

b. Connect vertical amplifier probe of oscilloscope to the signal generator output (ahead of the 10 uuf capacitor).

c. Connect frequency meter to the output of the signal generator (ahead of the 10 uuf capacitor).

d. Connect horizontal amplifier probe of oscilloscope to "J3409".

e. Tune signal generator to 100 kc at an output level of 3.0 volts rms.

f. Adjust core of T3407 to give a locked 2 to 1 Lissajous pattern on the oscilloscope. Rock signal generator tuning control above and below 100 kc to determine the limits of capture. The limits of capture should be ± 3 kc minimum.

g. Adjust core of T3407 as required to obtain a symmetrical range of capture around 100 kc.

h. Connect horizontal amplifier oscilloscope probe to "J3411".

i. With signal generator set to 100 kc at an output level of 3.0 volts rms note 20 to 1 locked Lissajous pattern on oscilloscope. Rock signal generator tuning control above and below 100 kc to determine the limits of capture. The capture range should be symmetrical around 100 kc and be ± 2 kc, minimum.

j. If these conditions can not be obtained, readjust R3433 for maximum capture range at proper division of frequency.

k. Disconnect oscilloscope probes and connect vertical amplifier probe to "J3409".

l. Set signal generator to 100 kc as monitored on the frequency meter at an output level of 3.0 volts rms.

m. A peak-to-peak measurement of 20 to 30 volts should be observed on the oscilloscope. The signals observed will be in the form of positive pulses. Check frequency at "J3410" and "J3411" with frequency meter to make certain the divider circuits are performing normally.

n. Connect vertical amplifier probe of oscilloscope to "J3411".

o. Repeat steps l and m for this measurement.

p. Disconnect all test equipment.

CAUTION

Never attempt realinement of the bandpass filters T3401, T3402, T33403, and T3406 or total misalinement may result. These filters are preset at the factory prior to installation in the subassembly. As this requires critical adjustment with special equipment, no attempt should be made to realine these filters. Where misalinement or other defect is noted in any of these filters, always replace the filter.

7-101. Final Test. Proceed as follows:

a. Connect output of signal generator to pin 15 of P3401.

b. Set signal generator frequency to 535 kc as monitored by the frequency meter at an output level of 1.0-volt rms as measured by the vtvm.

c. Connect a second signal generator through a 47 uuf capacitor to pin 10 of P3401.

d. Set this signal generator frequency to 232.5 kc as monitored by the frequency meter at an output level of 2.0 volts rms as measured by the vtvm.

e. Connect a 100 kc sine wave source of several volts to pin 1 of P3401. This input can be obtained from an audio oscillator.

f. Connect vertical amplifier oscilloscope probe to "J3405".

g. Rock signal generator tuning control slowly above and below the 232.5 kc setting and observe a low audio beat on the oscilloscope.

h. Connect vertical amplifier oscilloscope probe to "J3413" and repeat step g.

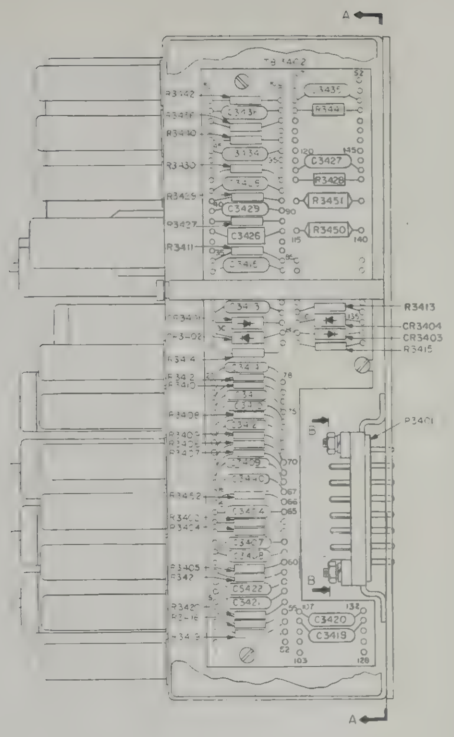
i. Connect output of signal generator connected in step a to pin 13 of P3401.

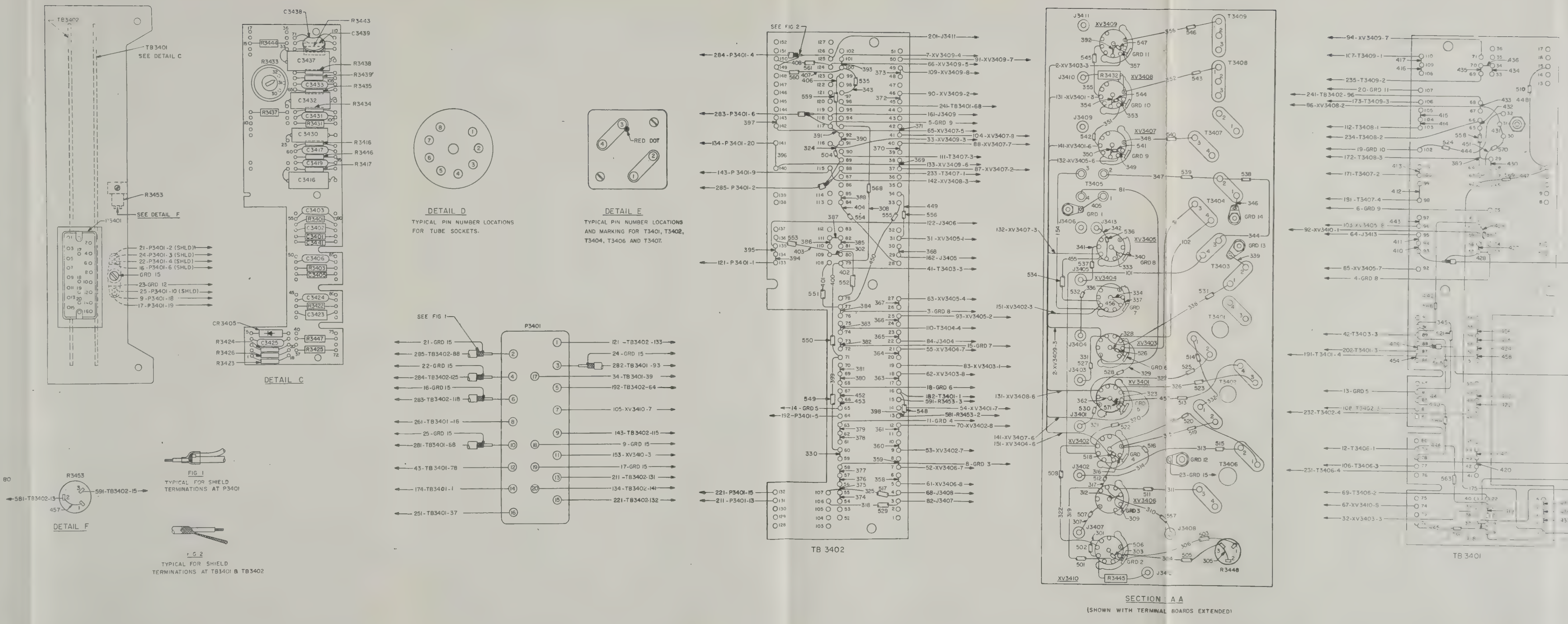
j. Repeat step g and observe audio beat on oscilloscope.

k. Satisfactory performance throughout the above test is an indication of a normally operating discriminator. Disconnect all test equipment.

7-102. DETAILED CIRCUIT ANALYSIS. The discriminator subassembly contains a frequency doubler, a frequency tripler, a divider-mixer, two mixers, three locked-oscillators, a phase inverter, three cathode followers, and a relay control stage. The doubler, one mixer, the divider-mixer, tripler, and phase inverter, along with a phase detector are used to derive the driving voltage required for the cathode follower which controls the relay control tube and reactance control circuit (see paragraph 7-66) in the cmo operation. The second mixer is used to combine the frequencies from the outputs of the dual crystal oscillator assembly and the three locked oscillators are used to supply (through cathode followers) the 5- and 50-kilocycle fundamental frequencies required to drive the respective harmonic amplifiers in the channelizer subassembly (see paragraph 7-69).

7-103. Referring to figure 7-37, it will be noted that the 230- to 235-kilocycle input at terminal 10 of P3401, is connected to the input of T3401 which couples the signal to the grid of V3401. Design parameters for this tube have been chosen for efficient operation as a doubler with the plate circuit broadly resonant within the range of 460 to 470 kilocycles. Transformer T3402 provides the resonant circuit and the coupling to the mixer stage, V3402. The second input to V3402 is provided by combining the two outputs of the dual crystal oscillator in the mixer stage, V3406. The resultant output frequency (530 to 540 kilocycles) is combined with the output frequency (460 to 470 kilocycles) of V3401 in the mixer stage, V3402, to produce a one-megacycle frequency at the grid of the divider-mixer, V3403. Coupling between V3402 and V3403 is accomplished by means of transformer, T3403. Frequency division is accomplished in the plate of V3403 by means of the resonant network, T3404 connected between the





NOTES

1- FORM AND LACE CABLE AS INDICATED USING LACING TAPE, ITEM 79
2- APPLY CEMENT, ITEM 81, TO ALL LACING KNOTS
3- ... ALL ELECTRICAL CONNECTIONS USING SOLDER, ITEM 80
4- ALL TERMINALS OF P3401 TO BE COVERED WITH SLEEVING, ITEM 78
5- FOR SCHEMATIC SEE 8(3)457)

Figure 7–38. Discriminator Subassembly Wiring Diagram

b. Connect vertical amplifier probe of oscilloscope to the signal generator output (ahead of the 10 uuf capacitor).

c. Connect frequency meter to the output of the signal generator (ahead of the 10 uuf capacitor).

d. Connect horizontal amplifier probe of oscilloscope to "J3409".

e. Tune signal generator to 100 kc at an output level of 3.0 volts rms.

f. Adjust core of T3407 to give a locked 2 to 1 Lissajous pattern on the oscilloscope. Rock signal generator tuning control above and below 100 kc to determine the limits of capture. The limits of capture should be ±3 kc minimum.

g. Adjust core of T3407 as required to obtain a symmetrical range of capture around 100 kc.

h. Connect horizontal amplifier oscilloscope probe to "J3411".

i. With signal generator set to 100 kc at an output level of 3.0 volts rms note 20 to 1 locked Lissajous pattern on oscilloscope. Rock signal generator tuning control above and below 100 kc to determine the limits of capture. The capture range should be symmetrical around 100 kc and be ±2 kc, minimum.

j. If these conditions can not be obtained, readjust R3433 for maximum capture range at proper division of frequency.

k. Disconnect oscilloscope probes and connect vertical amplifier probe to "J3409".

l. Set signal generator to 100 kc as monitored on the frequency meter at an output level of 3.0 volts rms.

m. A peak-to-peak measurement of 20 to 30 volts should be observed on the oscilloscope. The signals observed will be in the form of positive pulses. Check frequency at "J3410" and "J3411" with frequency meter to make certain the divider circuits are performing normally.

n. Connect vertical amplifier probe of oscilloscope to "J3411".

o. Repeat steps l and m for this measurement.

p. Disconnect all test equipment.

CAUTION

Never attempt realinement of the bandpass filters T3401, T3402, T33403, and T3406 or total misalinement may result. These filters are preset at the factory prior to installation in the subassembly. As this requires critical adjustment with special equipment, no attempt should be made to realine these filters. Where misalinement or other defect is noted in any of these filters, always replace the filter.

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c. Connect a second signal generator through a 47 uuf capacitor to pin 10 of P3401.

d. Set this signal generator frequency to 232.5 kc as monitored by the frequency meter at an output level of 2.0 volts rms as measured by the vtvm.

e. Connect a 100 kc sine wave source of several volts to pin 1 of P3401. This input can be obtained from an audio oscillator.

f. Connect vertical amplifier oscilloscope probe to "J3405".

g. Rock signal generator tuning control slowly above and below the 232.5 kc setting and observe a low audio beat on the oscilloscope.

h. Connect vertical amplifier oscilloscope probe to "J3413" and repeat step g.

i. Connect output of signal generator connected in step a to pin 13 of P3401.

j. Repeat step g and observe audio beat on oscilloscope.

k. Satisfactory performance throughout the above test is an indication of a normally operating discriminator. Disconnect all test equipment.

7–102. DETAILED CIRCUIT ANALYSIS. The discriminator subassembly contains a frequency doubler, a frequency tripler, a divider-mixer, two mixers, three locked-oscillators, a phase inverter, three cathode followers, and a relay control stage. The doubler, one mixer, the divider-mixer, tripler, and phase inverter, along with a phase detector are used to derive the driving voltage required for the cathode follower which controls the relay control tube and reactance control circuit (see paragraph 7–66) in the cmo operation. The second mixer is used to combine the frequencies from the outputs of the dual crystal oscillator assembly and the three locked oscillators are used to supply (through cathode followers) the 5- and 50-kilocycle fundamental frequencies required to drive the respective harmonic amplifiers in the channelizer subassembly (see paragraph 7–69).

7–103. Referring to figure 7–37, it will be noted that the 230- to 235-kilocycle input at terminal 10 of P3401, is connected to the input of T3401 which couples the signal to the grid of V3401. Design parameters for this tube have been chosen for efficient operation as a doubler with the plate circuit broadly resonant within the range of 460 to 470 kilocycles. Transformer T3402 provides the resonant circuit and the coupling to the mixer stage, V3402. The second input to V3402 is provided by combining the two outputs of the dual crystal oscillator in the mixer stage, V3406. The resultant output frequency (530 to 540 kilocycles) is combined with the output frequency (460 to 470 kilocycles) of V3401 in the mixer stage, V3402, to produce a one-megacycle frequency at the grid of the divider-mixer, V3403. Coupling between V3402 and V3403 is accomplished by means of transformer, T3403. Frequency division is accomplished in the plate of V3403 by means of the resonant network, T3404 connected between the

plate and screen grid of the tube. The resultant 100-kilocycle signal is coupled to the control grid of the tripler, V3404, through capacitor C3410, and to the control grid of the phase inverter, V3505A. The tripler stage converts the 100-kilocycle input to a 300-kilocycle output frequency in T3405. The output of this stage is then fed back to the control grid of V3403 where the third harmonic (900 kilocycles) heterodynes with the 1-megacycle signal at the suppressor grid to produce a sharply defined and amplified 100-kilocycle output for driving the phase inverter, V3405A. The latter stage is coupled to the phase detector consisting of the diodes CR3401, CR3402, CR3403, and CR3404, through capacitors C3413 and C3414. The 100-kilocycle sawtooth output of the reference oscillator subassembly (see paragraph 7–112) is also connected to one side of the phase detector for purposes of comparison. If there is a difference in the phase, the bridge will be unbalanced and a difference voltage will be applied to the grid of the cathode follower V3505B. The resultant change in potential at the cathode will then cause a change in the bias applied to the varicap diodes in the reactance circuit of the cmo (see paragraph 7–66) and also drive the relay control tube (V3410) grid to conduction. As the plate load of V3410 is the relay coil of K3302 (see paragraph 7–74), this relay will be energized. The potentiometer R3448 in the cathode circuit of V3410 is used to set the operating point of the tube after completing a repair or replacement.

7–104. The three locked-oscillator circuits in the discriminator subassembly consist of tubes V3407, V3408, and V3409. As noted in figure 7–37, the 100-kilocycle sine wave input signal (from the reference oscillator subassembly, described in paragraph 7–112) is connected through pin 2 of P3401 to the control grid of V3407A and one end of the tuned circuit contained in T3407. This circuit causes the tube to oscillate at one-half the input signal, or 50 kilocycles. In order to provide stability of operation and a low impedance output, the output is coupled through C3429 to the control grid of V3407B which serves as a cathode follower. The 50-kilocycle output is coupled through capacitor C3427, pin 6 of P3401, and the channelizer wiring to provide the fundamental driving frequency for the harmonic amplifier, V3303, located in the channelizer subassembly (see paragraph 7–69). The 50-kilocycle output from V3407A is also coupled through capacitor C3421 to the control grid of V3408A. A five-to-one frequency division takes place in this stage, to reduce the output to 10-kilocycles. This is accomplished by connecting the tube as an oscillator and tuning the resonant network, T3408 to a frequency of approximately 10 kilocycles. Further frequency division is then provided by means of the third locked-oscillator stage V3409A in order to get the required 5-kilocycle output. The 10-kilocycle input signal is coupled through the capacitor C3434 to the control grid of V3409A which is resonant and oscillating at a 5-kilocycle rate. Frequency of oscillation is controlled by the network comprising T3409. The output of V3409A is coupled to the control grid of V3409B through capacitor C3438. The latter stage is connected as a cathode follower in order to provide a stable output for V3049A, and also to provide a low impedance output to the line. The 5-kilocycle signal is coupled from the cathode of V3409B through capacitor C3435 to pin 4 of P3401. This output is then connected through the channelizer wiring to the 5-kilocycle harmonic amplifier circuit contained in the channelizer subassembly (see paragraph 7–69).

7–105. REFERENCE OSCILLATOR SUBASSEMBLY.

7–106. GENERAL DATA. The reference oscillator subassembly contains a one-megacycle crystal oscillator reference standard, the sub-harmonics of which are used to supply the single sideband carrier (250 kc) and the basic frequencies required for automatic tuning control of the channelizer subassembly. In addition, the automatic level control (alc) and the product detector (used for single sideband demodulation) stages are contained in this subassembly. When trouble is suspected in this subassembly, the minimum performance standards of paragraph 7–107 should be performed to make certain the unit contains a malfunction. A malfunction in the reference oscillator subassembly will affect the tuning circuits in the channelizer subassembly, single sideband operation of the equipment, and if the defect is in the alc circuit, a variation in the amplitude of the transmitter output will be noted. After making certain that a defect does exist, the unit should be checked in accordance with the trouble analysis chart of figure 7–39. If, while checking the output frequencies and voltages at the respective test points, the voltages are approximately normal, but the frequencies are not, realinement is indicated. Realinement of the various stages of the subassembly can be accomplished as outlined in paragraph 7–111. Figure 7–41 shows the location of the various test points provided and figure 7–42 is the schematic diagram of the subassembly. As no lubrication is required in this subassembly, the lubrication paragraph has been omitted.

7–107. MINIMUM PERFORMANCE STANDARDS. The following procedures should be performed when a reference oscillator subassembly is suspected of containing a defect and whenever a repair of replacement has been made. These checks can be made with the subassembly removed from and connected to the main chassis by means of the cable fabricated in Section III.

a. Operate the function switch on Radio Set Control CPC–1 to the "SSB/FSK" position and allow a minimum of 10 minutes to elapse before proceeding.

b. Connect the TS–375/U and the AN/USM–26 test probes to "J3505" and note the readings. A minimum measurement of 5 volts rms should be obtained at a frequency of 250 kilocycles.

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
1	J3505	VTVM TS-375/U and Frequency Meter AN/USM-26.	Function switch on Radio Set Control CPC-1 set to "SSB/FSK" position. Allow equipment to warmup for at least 10 minutes before proceeding.	5 volts rms, minimum at 250 kc ±1 cycle. Proceed to step 3.	Check V3501 and V3502 for quality and all associated voltages and resistance at the tube sockets in accordance with figure 7-40. Replace A3501 if suspected and re-check.
2	D1	VTVM TS-375/U.	Connect probe of TS-375/U to pin 2 of XA3501.	27.5 volts dc.	Check wiring to pin 15 of J319 and all associated chassis connections for defect.
3	J3503	VTVM TS-375/U and Frequency Meter AN/USM-26.	Same as step 1.	20 volts peak-to-peak minimum at 100 kc ±1 cycle. Proceed to step 4.	Check V3504 and all associated voltages and resistances at the tube socket in accordance with figure 7-40. Proceed to step 4.
4	J3502	Oscilloscope TEK 545.	Same as step 1.	15 to 20 volt, peak-to-peak sawtooth waveform. Proceed to step 5.	Check all parts associated with the 100-kc sawtooth generator, V3504A.
5	J3506	VTVM TS-375/U and Frequency Meter AN/USM-26.	Same as step 1.	1.75 volts rms at 500 kc ±1 cycle.	Check V3505 and all associated voltages, and resistance at the tube socket in accordance with figure 7-40.
6	D3 D4	VTVM TS-375/U and 60-cycle input source of 0.56 volt.	Same as step 1. Connect 60-cycle input to pin 9 of J319 and TS-375/U to pin 8.	-8 volts dc minimum.	Check V3506 and all associated voltages and resistance at the tube socket in accordance with figure 7-40.
7	J3501 D2	Signal Generator AN/USM-25, Oscilloscope TEK 545, and VTVM TS-375/U.	Same as step 1. Connect AN/USM-25 output to J3501 and TS-375/U and TEK 545 to pin 12 of J319. Adjust signal generator to 251 kc at an output level of 1 volt rms.	10 volts rms and undistorted sine wave.	Check V3503 and all associated voltages and resistance at the tube socket in accordance with figure 7-40.

Figure 7-39. Reference Oscillator Subassembly Trouble Analysis Chart

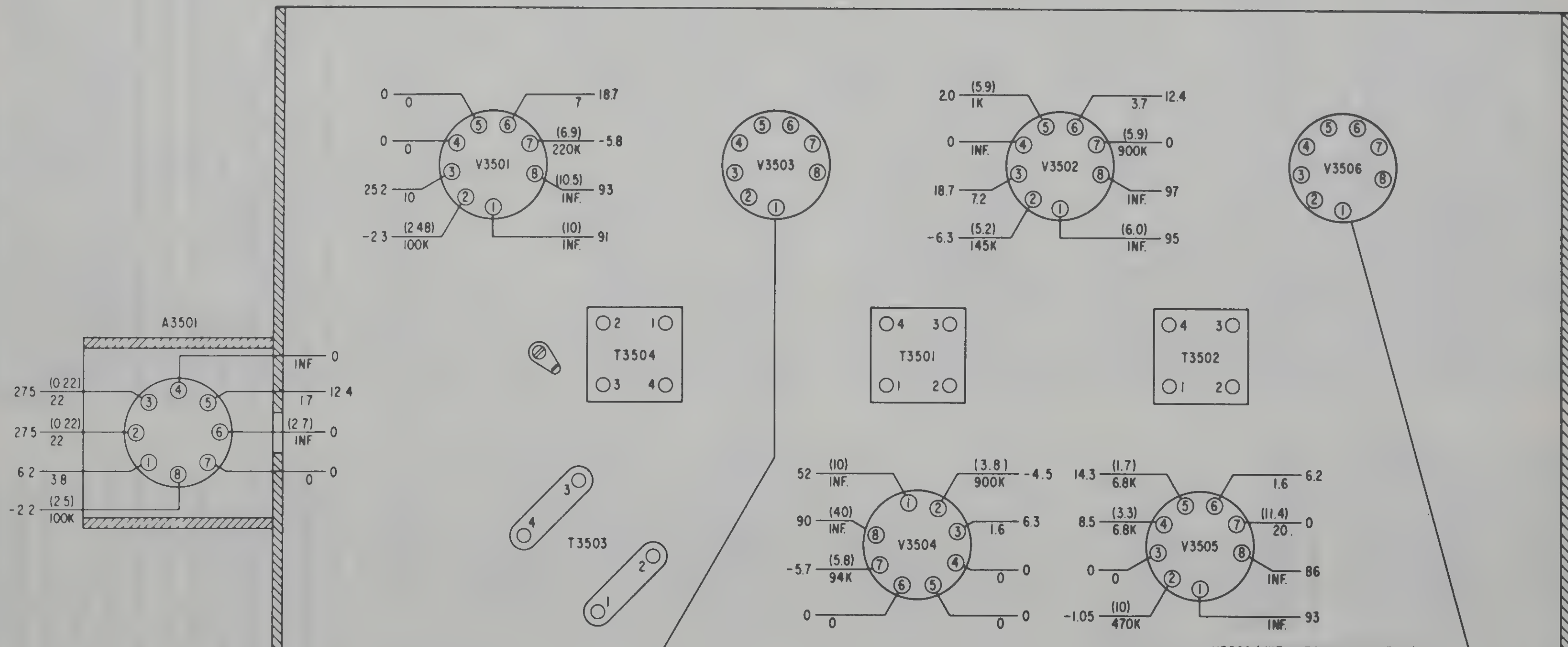
c. Connect the TS-375/U and the AN/USM-26 test probes to "J3503" and note the meter readings. A measurement of 22 volts peak-to-peak should be obtained at a frequency of 100 kilocycles ±1 cps.

d. Connect the oscilloscope probe to "J3502". A 15- to 20-volt, peak-to-peak, sawtooth waveform should be observed.

e. Connect the TS-375/U and AN/USM-26 probes to "J3504". A measurement of 6 volts rms at 500 kilocycles should be obtained.

7-108. CHECK-OUT OR ANALYSIS. If the subassembly fails to meet minimum performance standards, or the malfunction persists, check the unit in accordance with the normal point-to-ground operating voltages at the tube sockets as shown in figure 7-40. These voltages are to be measured with the subassembly in place in the main chassis and with tube socket adapters. If the voltage measurements are normal, realinement may be required. This can be accomplished as described in paragraph 7-111. If any voltage readings are abnormal, check all circuit components associated with the abnormal readings. Where defective operation is traced to the one-megacycle reference standard (A3501), the entire plug-in unit must be replaced as this is a potted module and can not be repaired in the field.

7-109. REMOVAL AND REPLACEMENT. Proceed as follows to remove the reference oscillator subassembly from the main chassis.



V3503 (RECEIVE ONLY)

MODE	AME/CW		SSB/FSK		
TUBE PIN	VOLTAGE		VOLTAGE		RES. (OHMS)
	DC	AC	DC	AC	
1	0	1.0	0	1.0	1.2K
2	0 67	0	0.88	0	820
3	6 2	0	6 2	0	1.7
4	0	0 14	-1 3	5.2	100K
5	0	0	78	10	INF
6	12 4	0	12 4	0	3 8
7	24	0	30	0	INF
8	0 67	0	0.88	0	820

NOTES:

1. A3501, V3501, V3502, V3504 AND V3505 READINGS SAME FOR AME/CW, SSB/FSK TRANSMIT MODES.
2. ALL READING WITH RESPECT TO GROUND.
3. EQUIPMENT TUNED TO 2.0 MC (BKBB).
4. AC AND DC READINGS MADE WITH VTVM.
5. RESISTANCE READINGS MADE WITH 20,000 OHM-PER-VOLT METER.
6. AC READINGS IN PARENTHESIS.

V3506 (WITH HEAVY MODULATION)

TUBE PIN	VOLTAGE		RES.	REMARKS
	DC	AC	(OHMS)	
1	9	10	INF	DC VOLTAGE GOES NEGATIVE WITHOUT MODULATION.
2	-69	0.15	INF	
3	12.4	0	3.7	DC VOLTAGE PINS 2, 3, 4, 6, AND 8 REMAINS STEADY REGARDLESS OF MODULATION.
4	-68	0.37	INF	
5	41	10	19K	
6	6.2	0	1.7	
7	37	10	490K	ALL AC VOLTAGES VARY WITH MODULATION. VOLTAGES LISTED ARE MAXIMUM.
8	150	0.3	INF	

Figure 7–40. Reference Oscillator Subassembly Tube Voltage and Resistance Diagram

a. Disconnect the four coaxial cables from the subassembly.

b. Loosen the three redheaded screws securing the subassembly to the chassis.

c. Pull subassembly straight up and out of the chassis receptacle.

7–110. The subassembly can be replaced by reversing the procedures of paragraph 7–109. Always make certain the plug pins are properly oriented in relation to the chassis receptacle before attempting to seat the subassembly. Tightening of the redheaded screws will seat the subassembly firmly in the receptacle. Make certain the coaxial connections are replaced in accordance with the color coding on the plugs and the jacks.

7–111. ALINEMENT AND ADJUSTMENT. The reference oscillator subassembly can be alined as follows:

a. Remove the reference standard assembly (A3501) from the subassembly.

b. Connect the unmodulated output of the signal generator to pin 6 of the tube socket from which the reference standard assembly was removed. Set the signal generator for an output frequency of one magecycle and an output level of 1 volt, using the frequency meter to assure correct frequency.

c. Connect the vertical amplifier input of the oscilloscope to J3506 and the horizontal amplifier input to the output of the signal generator.

d. Operate the function switch on the radio set control to the "SSB/FSK" position and allow a minimum of 10 minutes to elapse before proceeding.

e. If the 500-kilocycle oscillator is operating normally a locked 2-to-1 Lissajous pattern should be observed. If not, adjust the core of T3501 until the correct pattern is obtained. Adjust T3504 for maximum amplitude. When the locked pattern is obtained, rotate each core (one at a time) counterclockwise until the loss of lock point is reached. Note a reference point on the adjustment tool so that number of turns of the core can be counted. Turn the core clockwise (counting the number of turns) through the locking ranges until the loss of lock point is reached on the low side. Divide the number of turns by two and back the core out (counterclockwise) by this number of turns.

f. Disconnect the signal generator probe from the tube socket and replace the reference standard plug-in assembly (A3501) in the socket.

g. Connect the vertical amplifier input of the oscilloscope to "J3506" and the horizontal amplifier input to "J3507". If the preceding step alinement was correct and the 100-kilocycle oscillator is operating normally, a 5-to-1 Lissajous pattern will be observed. If not, adjust the core of T3503 until the correct locked pattern is obtained. Use the procedures described in step e to obtain correct adjustment. Because of the 5-to-1 division ratio, the locking range will be considerably narrower than that of the 2-to-1 division in the 500-kilocycle locked oscillator adjustment.

h. Connect the horizontal amplifier input of the oscilloscope to "J3505". If the 250-kilocycle oscillator is operating normally, a 2-to-1 Lissajous pattern will be observed. If not, adjust the core of T3502 as described in step e until the correct pattern is obtained.

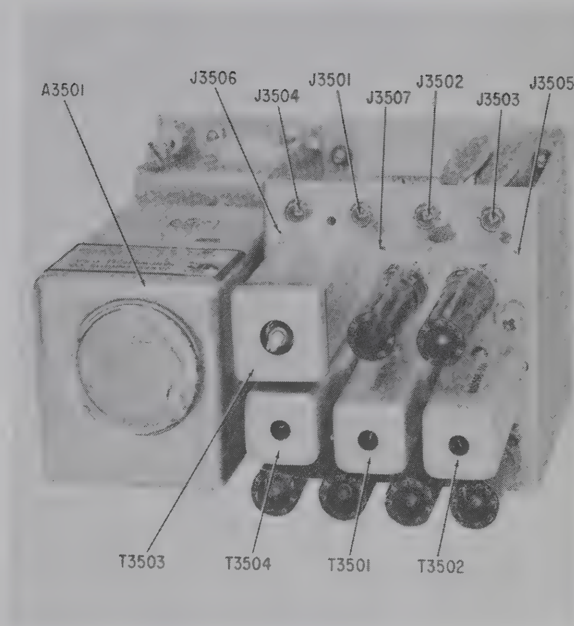


Figure 7–41. Reference Oscillator Subassembly Test Point and Alinement Locations

7–112. DETAILED CIRCUIT ANALYSIS. The reference oscillator subassembly provides the basic frequency standards required for operation of the radio set. Referring to figure 7–42, it will be noted that a one-megacycle crystal controlled oscillator stage (A3501) is used as the reference standard. This stage uses semiconductor circuitry and is enclosed in a potted plug-in enclosure. A buffer amplifier (V3501A) is used following the one-megacycle crystal controlled stage in order to provide amplitude stability. The one-megacycle output of the buffer stage is coupled through C3502 and limiting resistor R3504 to the control grid of a 2-to-1 frequency divider stage, V3501B. Frequency division is accomplished by operating the tube as an oscillator with its plate circuit tuned to one-half (500 kilocycles) of the input or locking frequency (one-megacycle). The output of V3501B is coupled through capacitor C3505 and the limiting resistor R3506 to a second 2-to-1 frequency divider, V3502A. The latter stage is also used as a locked oscillator to provide the carrier insert frequency of 250 kilocycles. Isolation of the plate circuit of V3502A and all external circuits is provided by the buffer tube V3502B. This tube is used as a cathode follower with its output coupled through capacitor C3514 to all external circuits and through

capacitor C3513 to the suppressor grid of the single sideband demodulator tube V3503. Operation of the latter tube is explained in paragraph 7–238.

7–113. The output of V3501B is also coupled through capacitor C3525 to one control grid of V3505 which is operated as a cathode follower. The cathode of this stage drives a tapped resonant circuit which gives a voltage stop up to drive a second cathode follower. The second cathode follower grid rectifies the signal and the resulting output at the cathode is a 500 kc pulse. Therefore, this stage will provide a sharply defined and amplified 500-kilocycle pulse to the harmonic amplifier in the channelizer subassembly. Coupling to the external circuits is accomplished by means of capacitor C3528 connected between the cathode of the second triode section and "J3504". Reference should be made to paragraph 7–198 which describes the operation of the alc circuit associated with tube V3506.

7–114. Capacitor C3521 is used to couple the output of V3501B to the input of the 100 kc sine wave generator V3504B. This stage operates as a locked oscillator with the resonant circuit tuned to one-fifth of the input frequency. The resultant 100-kc output is coupled through capacitor C3524 and a coaxial connector ("J3503") to the 50-kc locked oscillator in the discriminator subassembly. Capacitor C3518 also couples the output to the input of the 100-kc sawtooth generator tube V3504A. Coupling of the sawtooth output to external circuitry is accomplished by means of capacitor C3519 and the coaxial connector "J3502".

7–115. TUNER SUBASSEMBLY.

7–116. GENERAL DATA. The tuner subassembly contains the freqeuncy multiplying, mixer, and driver amplifiers required to operate the equipment as a transmitter. In addition, this subassembly contains the r-f and mixer amplifiers required to operate the equipment as a receiver. A variable i-f amplifier stage and a tuner discriminator circuit is also contained in this subassembly. These two circuits are common to the operation of the transmitter and receiver. The tuner discriminator circuit operates in conjunction with the tuner servo amplifier subassembly, band change assembly motor (B103), and the tuner servomotor (B102) located in the front panel subassembly to set the band change switches and tuner slugs to the resonant positions desired. Receiving and transmitting modes are selected by means of a self-contained relay and relays mounted on the main chassis and relay subassembly.

7–117. MININMUM PERFORMANCE STANDARDS. As the tuner subassembly contains no manual tuning controls, it must be in place on the main chassis to check the overall performance. Therefore, it is recommended that the tests outlined in paragraphs 2–12 through 2–18 be performed in order to check this subassembly. When operating in the transmit mode, it is recommended that the driving voltage appearing at jack "J001" be checked with a vtvm. If the subassembly is operating normally, the voltage measured should be between 61 and 66 volts rms. This check is to be made with J1001 disconnected and the transmitter keyed.

7–118. CHECK-OUT OR ANALYSIS. Before undertaking any of the troubleshooting steps for the tuner subassembly, make a visual inspection for mechanical faults such as a sticky slug rack, weak or broken springs on the slugs, broken slugs, loose or unmeshed gears, broken leads, solder shorts, and overheated detail parts. Check tubes V1001 through V1011. In troubleshooting the tuner subassembly, remember that several stages are common to both the receiving and transmitting circuits. This fact can be used in isolating troubles. If, for instance, the equipment functions properly during reception, but lacks drive to the power amplifier during transmission, the driver stages, V1010 and V1011, or the transmitter mixers, V1004 and V1003, are probably at fault. The preceding r-f tuner stages, V1108 and V1009, could not be defective and have the equipment function properly during reception. By a similar process of elimination, other faulty stages can be isolated.

7–119. Install tube adapters and measure r-f voltages at the grids and plates of the various tubes. Compare the readings with those shown in figure 7–45. This will help to isolate the trouble to the defective stage in the tuner subassembly. After isolating the trouble to its stage, make voltage and resistance checks to determine the faulty detail part. Check the operation of the tuner discriminator circuit by measuring the d-c voltage at pin 4 of J308 (test point c). During channeling cycle, a d-c voltage, varying in amplitude and polarity, should be measured. A zero reading should be obtained after the channeling cycle is completed. If the tuner slug rack centers when a new frequency is selected but will not tune, the trouble is in the tuner discriminator circuit. If the slug rack will move in one direction only, a portion of the tuner discriminator network (Z1001) is defective. In isolating the trouble to a particular detail part, operate the equipment on each of the bands. This will aid in isolating the trouble to one stage. If the trouble is due to misalinement, perform applicable portions of paragraphs 7–121 through 7–130. Refer to figure 7–44 for trouble isolation procedures.

7–120. REMOVAL AND REPLACEMENT. Perform the following operation when removing and replacing the tuner subassembly.

a. Tune the radio set to an output frequency of 2.0 megacycles ("BKBB").

b. The red identification dots on the two front Oldham couplers should be straight up as shown in figure 7–48.

c. Loosen the four redheaded captive screws until they rotate freely.

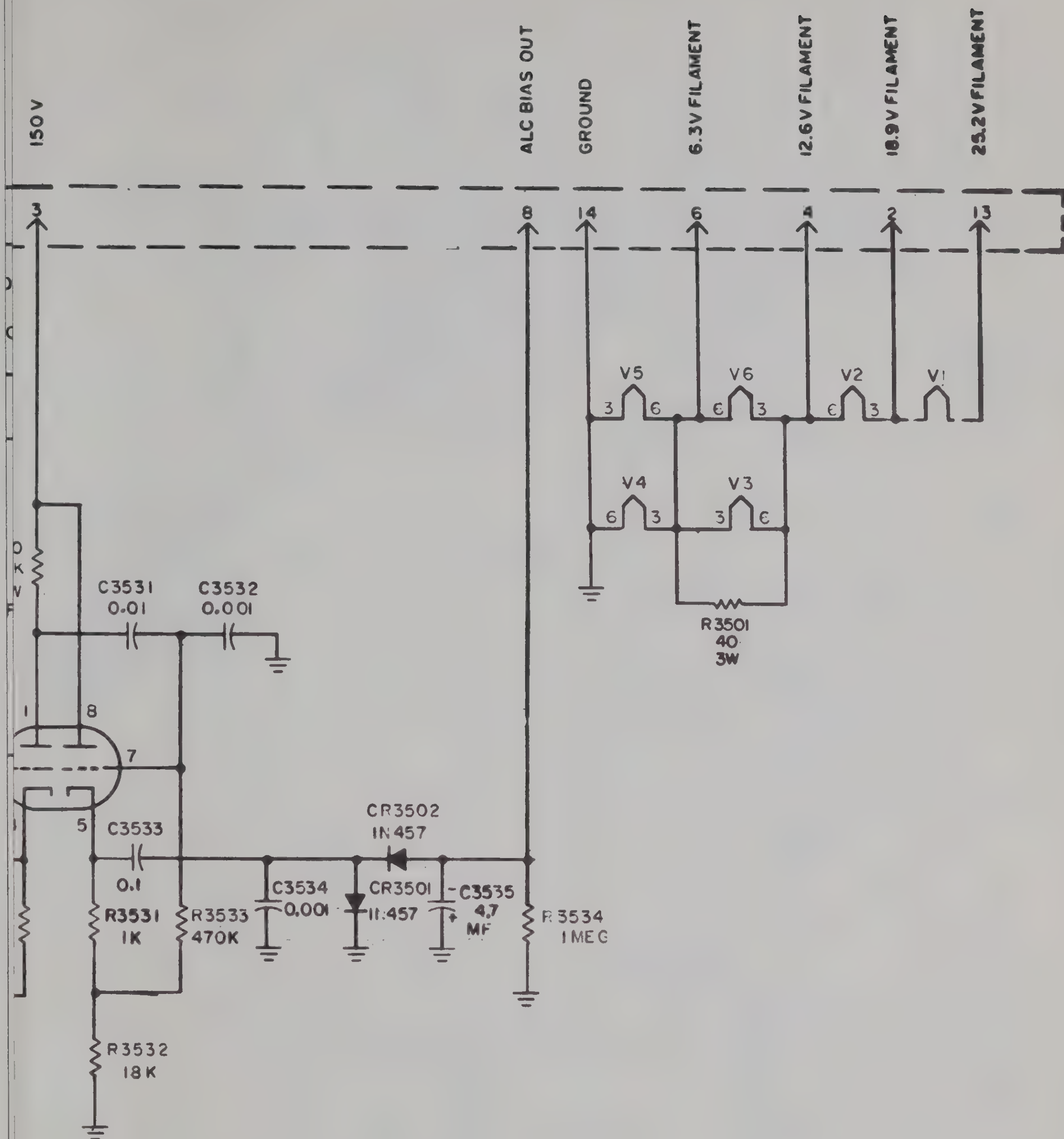


Figure 7-42. Reference Oscillator Subassembly, Schematic Diagram

capacitor C3513 to the suppressor grid of the single sideband demodulator tube V3503. Operation of the latter tube is explained in paragraph 7-238.

7-113. The output of V3501B is also coupled through capacitor C3525 to one control grid of V3505 which is operated as a cathode follower. The cathode of this stage drives a tapped resonant circuit which gives a voltage stop up to drive a second cathode follower. The second cathode follower grid rectifies the signal and the resulting output at the cathode is a 500 kc pulse. Therefore, this stage will provide a sharply defined and amplified 500-kilocycle pulse to the harmonic amplifier in the channelizer subassembly. Coupling to the external circuits is accomplished by means of capacitor C3528 connected between the cathode of the second triode section and "J3504". Reference should be made to paragraph 7-198 which describes the operation of the alc circuit associated with tube V3506.

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7-117. MININMUM PERFORMANCE STANDARDS. As the tuner subassembly contains no manual tuning controls, it must be in place on the main chassis to check the overall performance. Therefore, it is recommended that the tests outlined in paragraphs 2-12 through 2-18 be performed in order to check this subassembly. When operating in the transmit mode, it is recommended that the driving voltage appearing at jack "J001" be checked with a vtvm. If the subassembly is operating normally, the voltage measured should be between 61 and 66 volts rms. This check is to be made with J1001 disconnected and the transmitter keyed.

7-118. CHECK-OUT OR ANALYSIS. Before undertaking any of the troubleshooting steps for the tuner subassembly, make a visual inspection for mechanical faults such as a sticky slug rack, weak or broken springs on the slugs, broken slugs, loose or unmeshed gears, broken leads, solder shorts, and overheated detail parts. Check tubes V1001 through V1011. In troubleshooting the tuner subassembly, remember that several stages are common to both the receiving and transmitting circuits. This fact can be used in isolating troubles. If, for instance, the equipment functions properly during reception, but lacks drive to the power amplifier during transmission, the driver stages, V1010 and V1011, or the transmitter mixers, V1004 and V1003, are probably at fault. The preceding r-f tuner stages, V1108 and V1009, could not be defective and have the equipment function properly during reception. By a similar process of elimination, other faulty stages can be isolated.

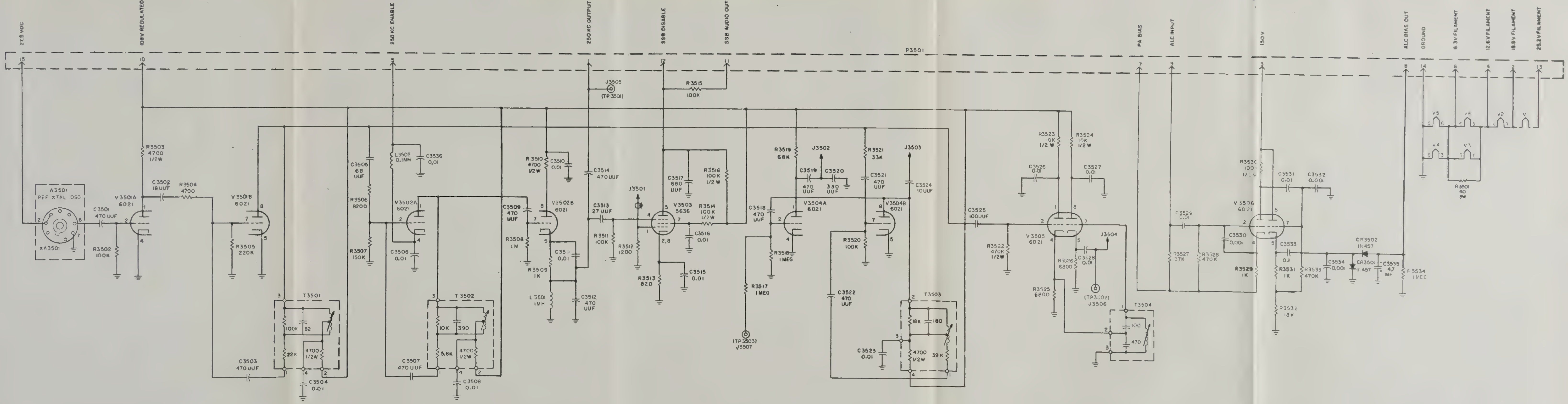
7-119. Install tube adapters and measure r-f voltages at the grids and plates of the various tubes. Compare the readings with those shown in figure 7-45. This will help to isolate the trouble to the defective stage in the tuner subassembly. After isolating the trouble to its stage, make voltage and resistance checks to determine the faulty detail part. Check the operation of the tuner discriminator circuit by measuring the d-c voltage at pin 4 of J308 (test point c). During channeling cycle, a d-c voltage, varying in amplitude and polarity, should be measured. A zero reading should be obtained after the channeling cycle is completed. If the tuner slug rack centers when a new frequency is selected but will not tune, the trouble is in the tuner discriminator circuit. If the slug rack will move in one direction only, a portion of the tuner discriminator network (Z1001) is defective. In isolating the trouble to a particular detail part, operate the equipment on each of the bands. This will aid in isolating the trouble to one stage. If the trouble is due to misalinement, perform applicable portions of paragraphs 7-121 through 7-130. Refer to figure 7-44 for trouble isolation procedures.

7-120. REMOVAL AND REPLACEMENT. Perform the following operation when removing and replacing the tuner subassembly.

a. Tune the radio set to an output frequency of 2.0 megacycles ("BKBB").

b. The red identification dots on the two front Oldham couplers should be straight up as shown in figure 7-48.

c. Loosen the four redheaded captive screws until they rotate freely.



NOTES:
1. ALL RESISTANCE VALUES ARE IN OHMS UNLESS OTHERWISE INDICATED.
2. ALL CAPACITORS ARE IN UF UNLESS OTHERWISE INDICATED.

Figure 7–42. Reference Oscillator Subassembly, Schematic Diagram

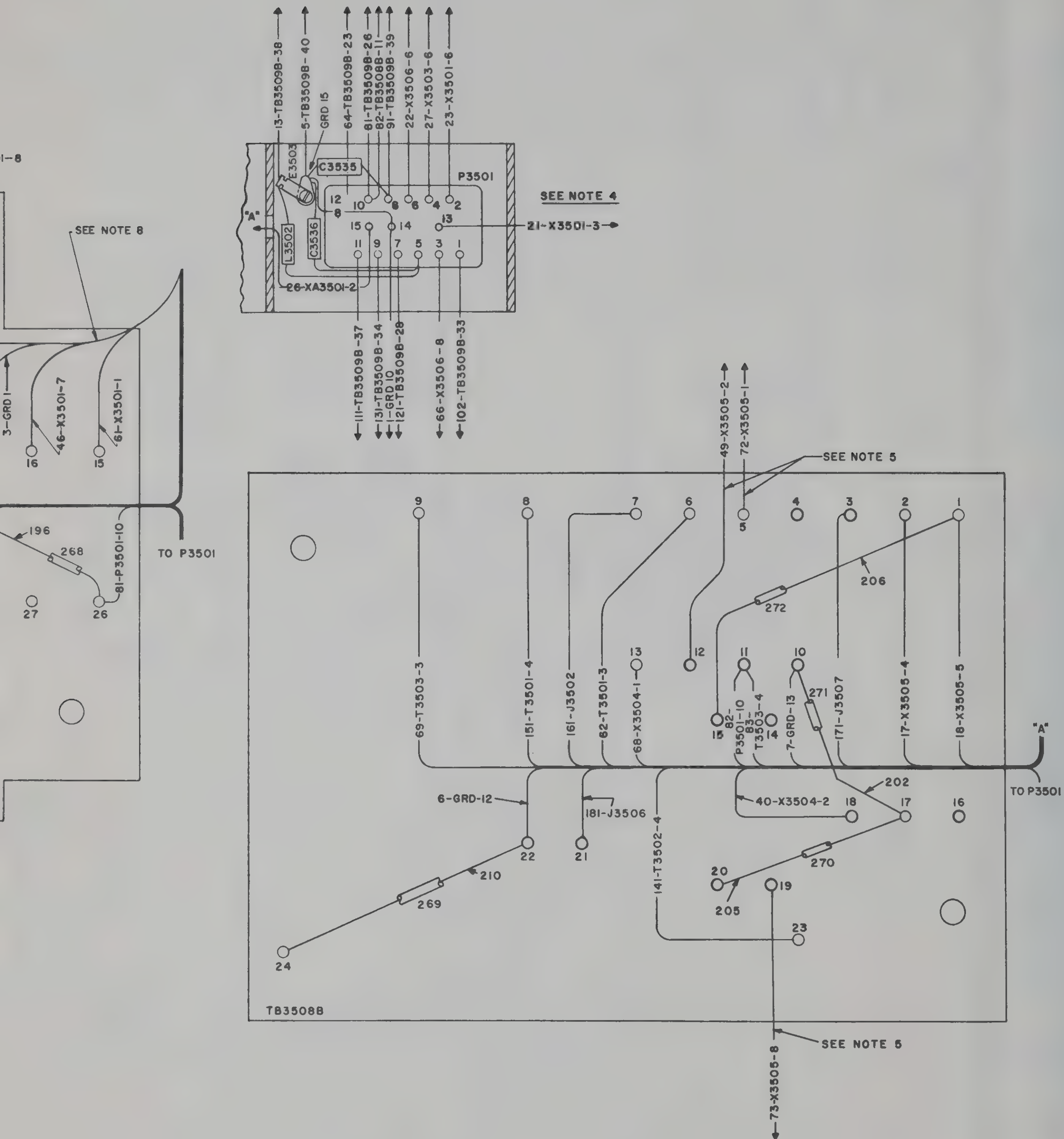
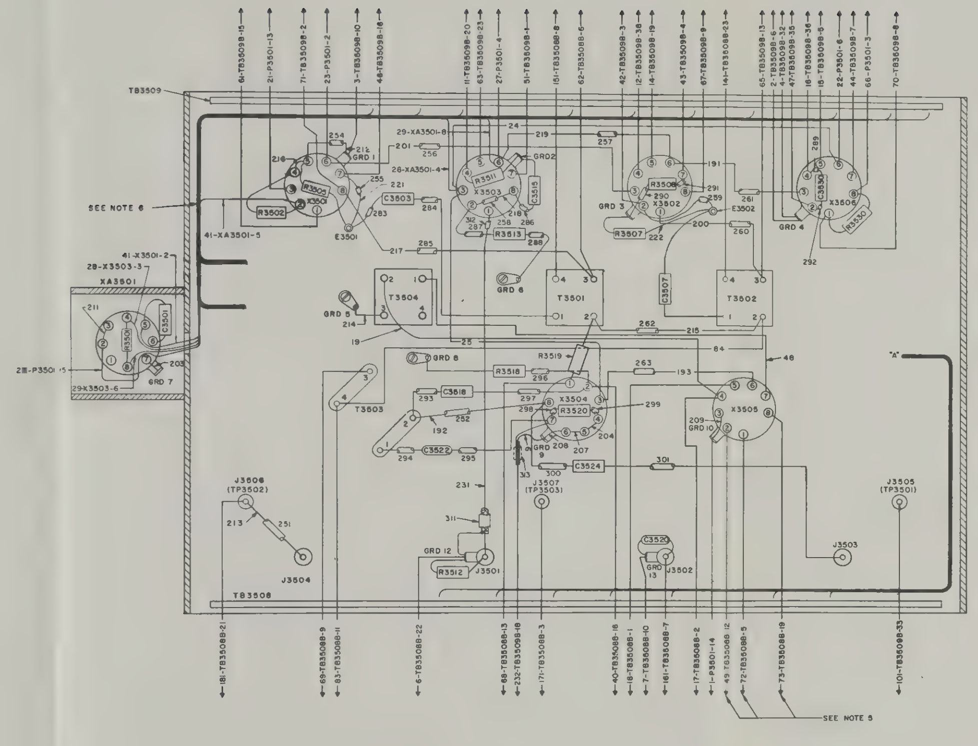


Figure 7–43. Reference Oscillator Subassembly Wiring Diagram

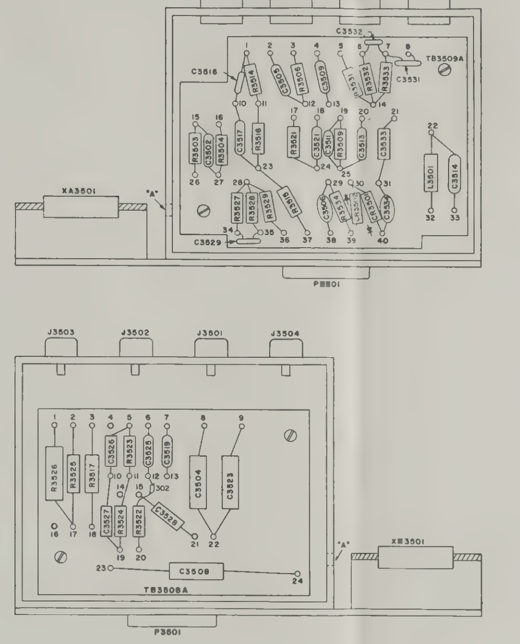
Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
1	Visual	None	Function switch on Radio Set Control CPC–1 to "AME" position and "CHANNEL" select switches set to any new position.	Slug rack should return to center position (tables) before setting up to new frequency.	1a. Check S1007 operation and contact closure. 1b. Check operation of K802 in relay subassembly and K3001 in channelizer subassembly. 1c. Check tuner servo amplifier subassembly as outlined in paragraph 7–150.
2	Visual	None	Same as step 1.	Slug rack does not change position.	2a. Check servo motor B102 located in front panel subassembly as outlined in paragraph 7–212. 2b. Check as in steps 1a, 1b, and 1c; also check for defective mechanical drive.
3	Visual	None	Same as step 1.	Slug rack centers but does not set up new frequency.	3a. Check V1001 and associated voltages and resistances as shown in figure 7–45. 3b. Check CR1001 through CR1005 and all associated detail parts for quality. 3c. Check as in steps 1a, 1b, and 1c.
4	Visual	None	Filaments do not light.	All filaments have normal brillance.	4a. Locate and replace defective tube. 4b. Check R1046 for value. 4c. Check mating contacts of P1001/J307 and P1002/J308 for positive contact.
5	A	VTVM TS/375/U	Same as step 1 with "CHANNEL" select switches set to any position and transmitter keyed.	65 volts rms.	5a. Check V1002, V1003, V1004, V1007, V1009, V1010, and V1011 voltages and restances as shown in figure 7–45. 5b. Check all detail parts associated with these tube circuits for quality. 5c. Check P1001/J307 and P1002/J308 contacts and J1001 cable for short circuit. 5d. Check operation of K1001.
6	Aural	Headset H–1/AR or H–1/4AR	Function switch on Radio Set Control CPC–1 set to "AME" position and "CHANNEL" select switches set to any frequency Monitor receiver output with headset.	Normal receiver sensitivity noted.	6a. If there is weak or no output from the receiver, check voltages and resistances at the tube socket pins of V1002 and V1005 through V1009. 6b. Check all detail parts associated with any tube having abnormal voltage and restance measurements. 6c. Check operation of K1001, K302, and K303.

Figure 7–44. Tuner Subassembly Trouble Analysis Chart (Sheet 1 of 2)



NOTES:

1. FORM AND LACE CABLE USING LACING CORD ITEM 62
2. APPLY VARNISH ITEM 64 TO ALL LACING KNOTS.
3. CRIMP AND SOLDER ALL ELECTRICAL CONNECTIONS USING ITEM 63.
4. COVER PINS OF P3501 WITH SLEEVING ITEM 66, EXCEPT PINS 8,10 & 14 WHEN ITEM 68 IS USED.
5. DO NOT PUT THESE LEADS IN CABLE, MAKE DIRECT POINT TO POINT CONNECTIONS.
6. WHEN WIRING THIS PORTION OF CHASSIS PUT LEADS IN APPROPRIATE CABLE.
7. FOR SCHEMATIC SEE 8314533
8. THIS CABLE NOT TO BE TIED TIGHT AND TAKE ALL LEADS TO THEIR RESPECTIVE TERMINALS WITH NO EXCESS WIRE.



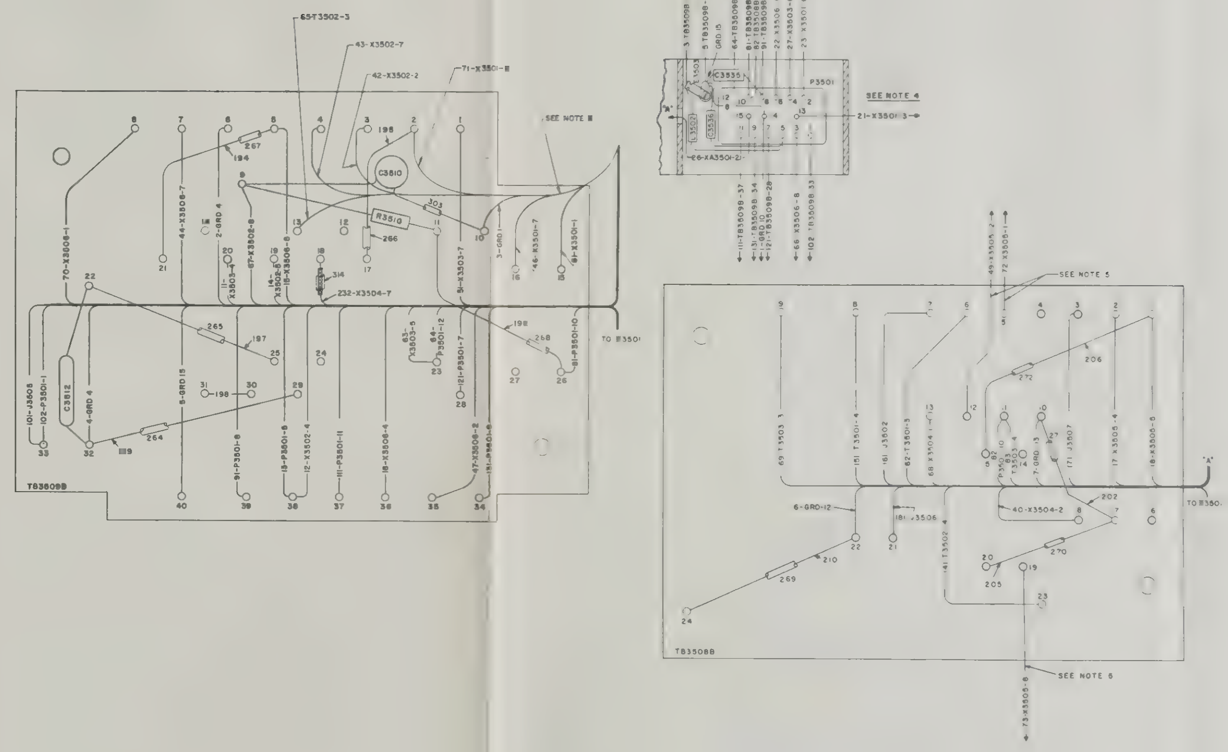


Figure 7–43. Reference Oscillator Subassembly Wiring Diagram

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
1	Visual	None	Function switch on Radio Set Control CPC-1 to "AME" position and "CHANNEL" select switches set to any new position.	Slug rack should return to center position (tables) before setting up to new frequency.	1a. Check S1007 operation and contact closure. 1b. Check operation of K802 in relay subassembly and K3001 in channelizer subassembly. 1c. Check tuner servo amplifier subassembly as outlined in paragraph 7-150.
2	Visual	None	Same as step 1.	Slug rack does not change position.	2a. Check servo motor B102 located in front panel subassembly as outlined in paragraph 7-212. 2b. Check as in steps 1a, 1b, and 1c; also check for defective mechanical drive.
3	Visual	None	Same as step 1.	Slug rack centers but does not set up new frequency.	3a. Check V1001 and associated voltages and resistances as shown in figure 7-45. 3b. Check CR1001 through CR1005 and all associated detail parts for quality. 3c. Check as in steps 1a, 1b, and 1c.
4	Visual	None	Filaments do not light.	All filaments have normal brillance.	4a. Locate and replace defective tube. 4b. Check R1046 for value. 4c. Check mating contacts of P1001/J307 and P1002/J308 for positive contact.
5	A	VTVM TS/375/U	Same as step 1 with "CHANNEL" select switches set to any position and transmitter keyed.	65 volts rms.	5a. Check V1002, V1003, V1004, V1007, V1009, V1010, and V1011 voltages and restances as shown in figure 7-45. 5b. Check all detail parts associated with these tube circuits for quality. 5c. Check P1001/J307 and P1002/J308 contacts and J1001 cable for short circuit. 5d. Check operation of K1001.
6	Aural	Headset H-1/AR or H-1/4AR	Function switch on Radio Set Control CPC-1 set to "AME" position and "CHANNEL" select switches set to any frequency Monitor receiver output with headset.	Normal receiver sensitivity noted.	6a. If there is weak or no output from the receiver, check voltages and resistances at the tube socket pins of V1002 and V1005 through V1009. 6b. Check all detail parts associated with any tube having abnormal voltage and restance measurements. 6c. Check operation of K1001, K302, and K303.

Figure 7-44. Tuner Subassembly Trouble Analysis Chart (Sheet 1 of 2)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
7	1 5	VTVM TS–375/U, Audio Oscillator TS–382/U (2 required), dummy microphone, Oscilloscope TEK 545, Bird Model 82 dummy load, 25 $\mu\mu$f capacitor as shown in figure 2–2.	Function switch on Radio Set Control CPS–1 set to "SSB/FSK" position and transmitter keyed.	50-volts rms, minimum.	7a. If there is no transmission in the "SSB/FSK" position, check the reference oscillator subassembly as outlined in paragraph 7–108. 7b. Check V1004 and all associated voltages and resistances as shown in figure 7–45. 7c. Check operation of K1001, and K301 through K305. 7d. Check modulator subassembly as outlined in paragraph 7–180.
8	Visual	None	Function switch on Radio Set Control CPC–1 set to "AME" or "SSB/FSK" mode. Transmitter keyed and modulated.	Constant amplitude modulated r-f signal monitored at output.	8a. If amplitude of signal varies, check for alc voltage at pin 1 of V1009 and pin 10 of P1001. 8b. If absent, check reference oscillator subassembly as outlined in paragraph 7–108 and operation of V1408 in modulator subassembly as outlined in paragraph 7–180.
9	1	Frequency Meter AN/USM–26, Bird Model 82 Dummy Load.	Function switch on Radio Set Control CPC–1 set to any mode. Set "CHANNEL" select switches to several frequencies in each band; key transmitter for each frequency.	Constant r-f carrier without frequency variation.	9a. If frequency varies, check quality of CR1005 and associated parts. 9b. Check V1002 and associated voltages and resistances as shown in figure 7–45. 9c. Check R1006 and if necessary, correct as described in paragraph 7–130.

Figure 7–44. Tuner Subassembly Trouble Analysis Chart (Sheet 2 of 2)

d. Disconnect plug P1503 from jack J1001.

e. Lift the tuner subassembly straight up and out of the main chassis receptacles.

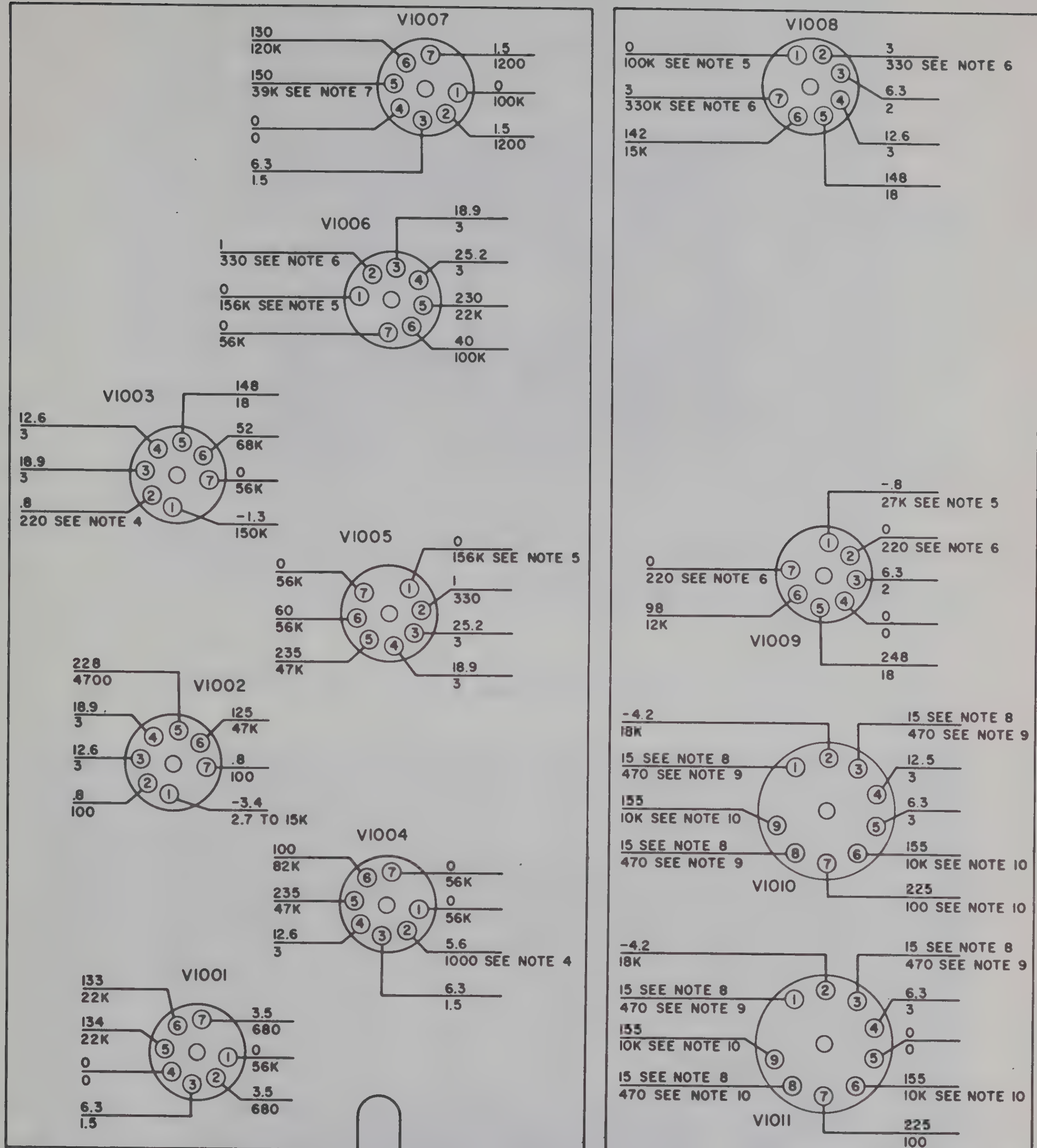
f. When reinstalling the tuner subassembly, the red dots on the two front Oldham couplers secured to the tuner subassembly should be straight. The long cut-out on the slider portion of the couplers attached to the band change auto positioner unit and servomotor B102 unit, should be vertical and the pin toward the bottom. The rear coupler, attached to the power amplifier subassembly, should have the slider portion vertical and the pin toward the bottom.

g. Insert the tuner subassembly carefully, observing that all couplers are properly matched.

CAUTION

The pin on the slider portion of the Oldham coupler must match the 90-degree cutout of the fixed portion of the Oldham coupler when reinstalling a subassembly.

h. Tighten the four redheaded captive screws alternately to seal the subassembly properly.



NOTES:
1. VOLTAGE MEASUREMENTS TAKEN DURING CW TRANSMISSION.
2. RESISTANCE MEASUREMENTS TAKEN WITH 618S-1/MC REMOVED FROM 350S-1 OR 350S-3 AND P301-14 GROUNDED TO CHASSIS.
3. ALL MEASUREMENTS WITH RESPECT TO CHASSIS GROUND.
4. MEASUREMENT TAKEN WITH J308-10 GROUNDED TO CHASSIS.
5. MEASUREMENT TAKEN WITH J307-11 GROUNDED TO CHASSIS.
6. MEASUREMENT TAKEN WITH J307-15 GROUNDED TO CHASSIS.
7. MEASUREMENT TAKEN IN BAND 3 POSITION.
8. MEASUREMENT TAKEN IN BAND 1 POSITION.
9. MEASUREMENT TAKEN IN BAND 1 POSITION WITH J307-5 GROUNDED TO CHASSIS.
10. MEASUREMENT TAKEN WITH J307-1 GROUNDED TO CHASSIS
11. ALL VOLTAGES ARE D-C UNLESS OTHERWISE INDICATED.

Figure 7–45. Tuner Subassembly Tube Voltage and Resistance Diagram

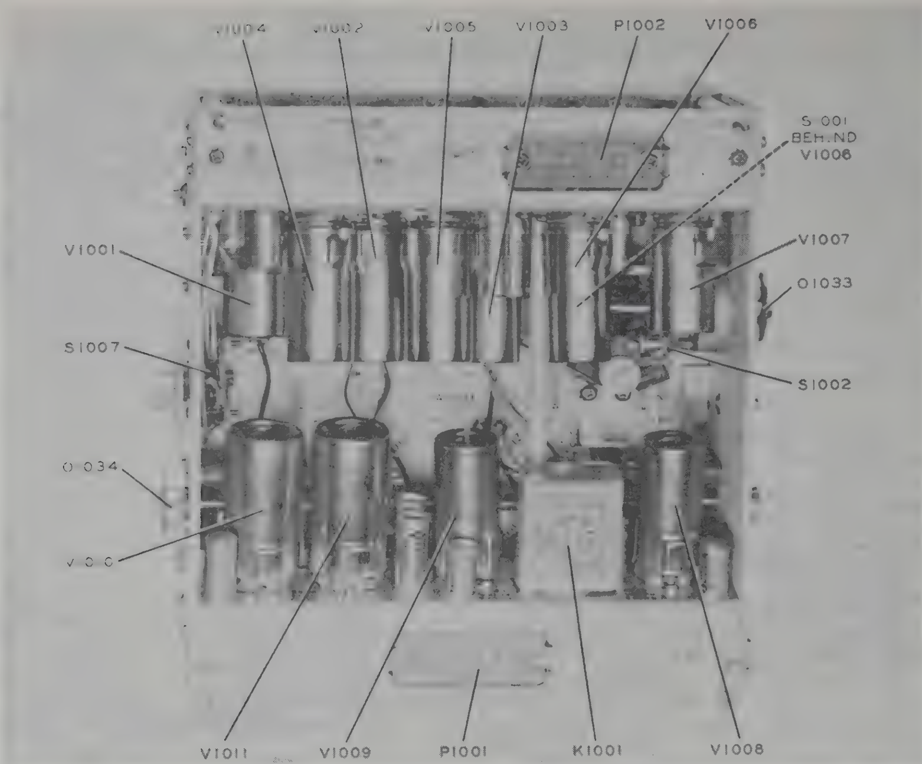


Figure 7–46. Tuner Subassembly, Bottom View, Switch and Tube Locations

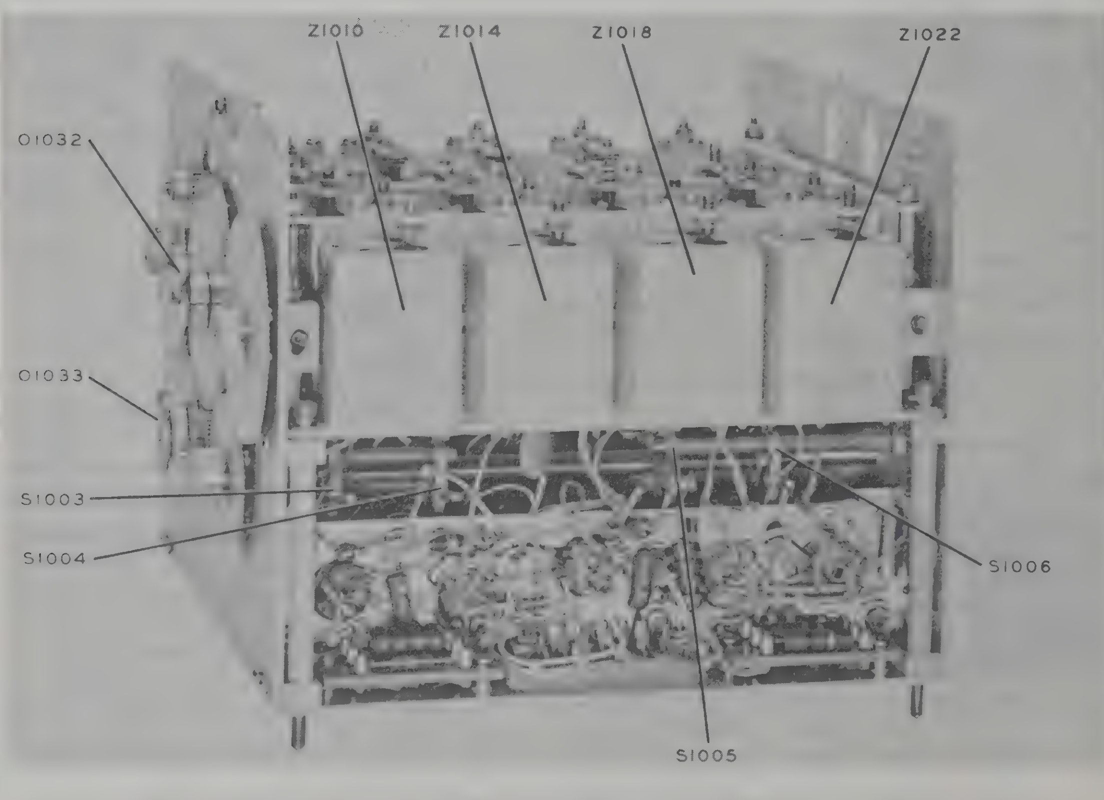


Figure 7–47. Tuner Subassembly, Right Side View, Switch and Coupler Location

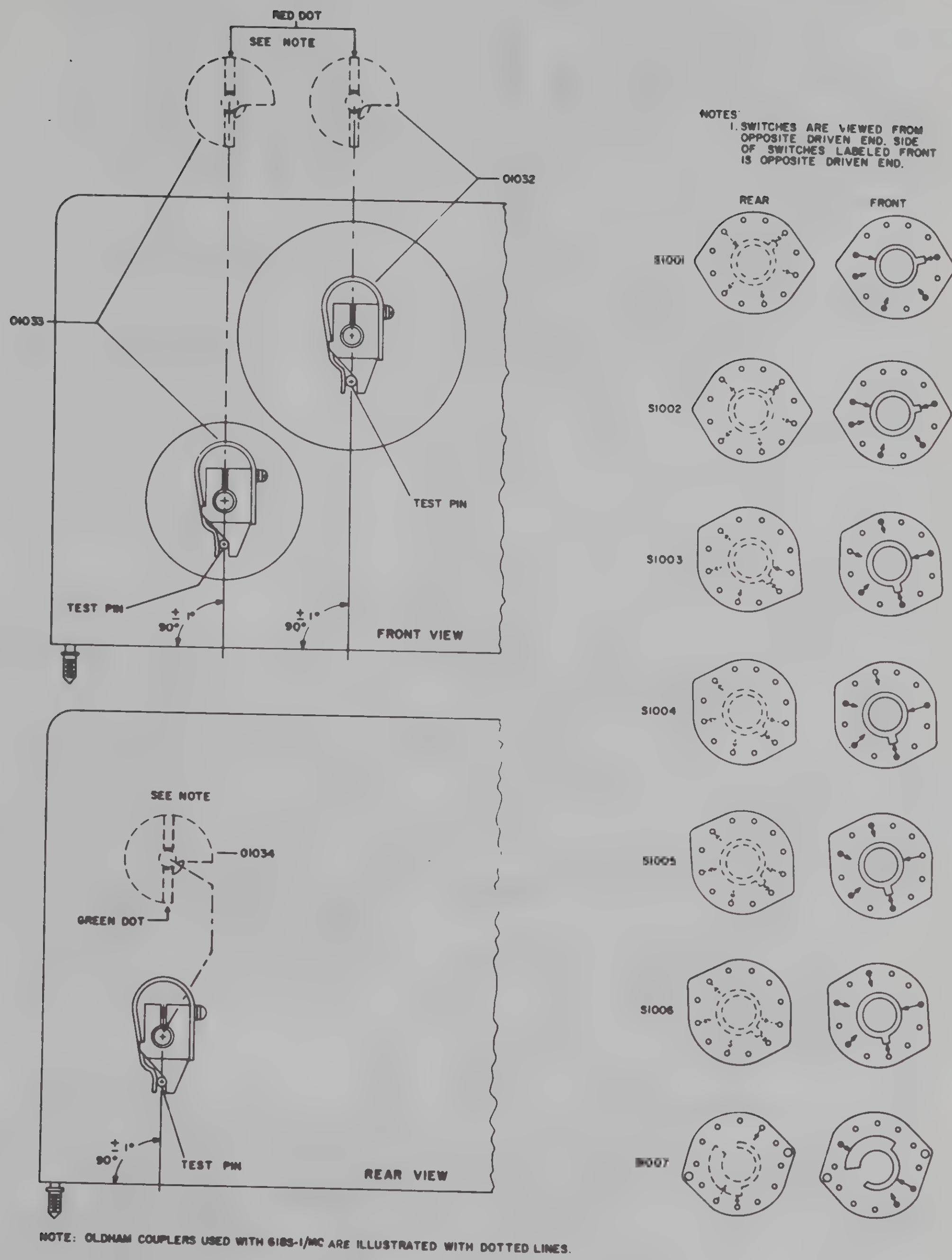


Figure 7–48. Tuner Subassembly, Switch and Coupler Alinement

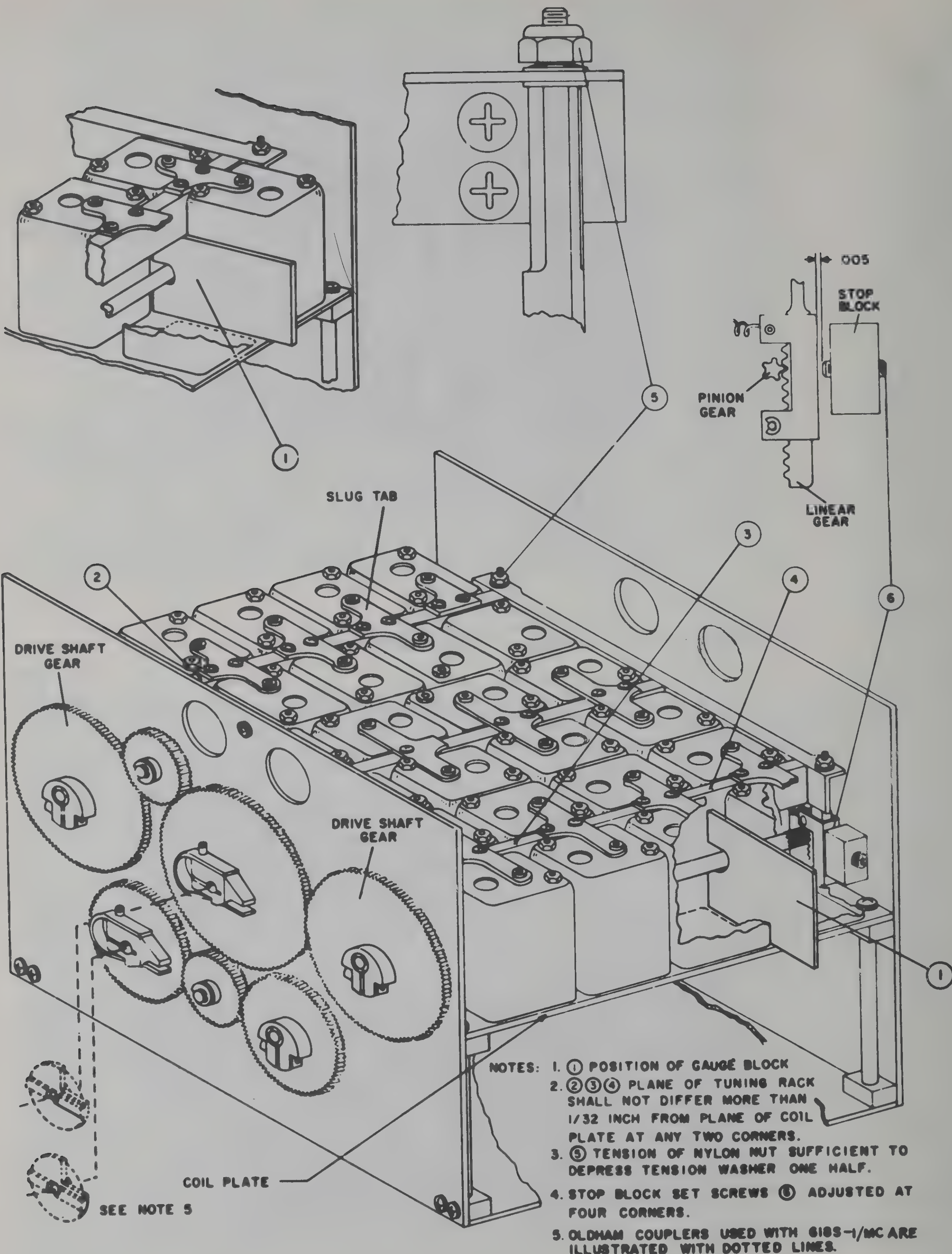


Figure 7-49. Tuner Subassembly Mechanical Alinement Points

7-121. ALINEMENT AND ADJUSTMENT. Paragraphs 7-122 through 7-130 describe the adjustment procedures for the tuner subassembly. The tuner subassembly should be removed during the mechanical alinement procedures and installed in the main chassis during the electrical alinement procedures. Reference is made to paragraph 7-120 for the removal and replacement procedures. During electrical alinement, the subassembly should be connected to a test bench setup similar to figure 2-2. All test points are identified on the bottom view of the main chassis, figure 7-3 and on figure 7-57. All electrical and mechanical alinement points are identified in figures 7-46 through 7-51.

7-122. Coupler and Switch Adjustments. Refer to figures 7-46 through 7-49. Perform the following operations:

a. Tune the radio set to 2.0 ("BKBB") megacycles and remove tuner subassembly from the main chassis. Refer to paragraph 7-120.

b. Position the Oldham couplers as indicated in dotted lines in figure 7-48. The tuning rack should be in its bottom position. The extruded portion of the Oldham couplers should be orientated vertically, perpendicular ±1 degree to the plane of the tuner subassembly bottom.

Note

The tuning rack is in its bottom position when the bottom side of the tuning rack is 1.375 (1-3/8) inches from the top side of the coil plate. The gauge block may be used to measure this distance. Refer to figure 7-49 for positioning of the gauge block.

c. All switch rotors should aline in the positions indicated in figure 7-48.

d. If either the tuning rack or one or more of the switch rotors are misalined, rotate the coupler with respect to its shaft until the ±1 degree perpendicular is obtained. The one degree may be determined by using a right angle with the tuner subassembly resting level on the test bench.

Note

This ±1 degree tolerance must be maintained if complete interchangeability between subasemblies of various systems is to be achieved.

7-123. Tuning Rack Adjustments. Certain mechanical adjustments are necessary in addition to the coupler and switch alinement procedures. These adjustments are very important and should be completed before advancing to the electrical alinement procedures, paragraphs 7-124 through 7-130. Perform the following operations with reference to figure 7-49.

a. Slug drag: To remedy slug drag, place the tuning rack in its bottom position on the gauge block and center the misalined slug in its coil. This may be accomplished by loosening the two Phillips-head screws securing the slug and adjusting the slug tab.

b. Tuning rack lock nuts: The four lock nuts (nylon) should be tightened until the tension washers are compressed approximately one-half. The linear gears must have freedom to slide in slots of the tuning rack. See figure 7-49, item 5.

c. Plane of tuning rack: The plane of the tuning rack should not differ from the plane of the coil plate by more than 1/32 inch when measured at any two corners. If either side is off, loosen the clamp on the drive shaft gear and adjust the tuning rack for correct height. If any one corner is off, loosen the setscrew of the applicable stop block and disengage the linear gear from the pinion gear. The plane of the tuning rack now may be adjusted to correct the height. See figure 7-49, items 2, 3, 4, and 6.

d. Adjustment of stop block setscrews: To prevent the linear gear from slipping a tooth with respect to the pinion gear in the event of severe jarring, a stop block with a setscrew has been placed on the tuner subassembly frame. The setscrew in the stop block limits the distance that the linear gear carriage may move. Spacing between the setscrew and the linear gear carriage should be 0.005 inch. This 0.005-inch spacing may be accomplished by using a shim or spacer. Make this adjustment on all four corners. Refer to figure 7-49, item 6.

7-124. Tuner Discriminator Adjustments. Perform the following operations with reference to figures 7-49 through 7-51.

a. Return the tuner subassembly to the main chassis.

b. Connect in a test bench setup similar to figure 2-2.

c. Operate the function switch to the "AME" position and allow at least 10 minutes for warmup.

d. Select the 2.0 megacycles ("BKBB") position.

e. Place the gauge block in position in the tuner subassembly. Refer to figure 7-50.

Note

If the slug rack is positioned so that the gauge block will not slip into place, turn the slug of T1001 clockwise a few turns. This will raise the slug rack.

f. Adjust the slug of T1001 until the slug rack just touches the gauge block.

g. Clamp the dial gauge to the rear panel with the measuring shaft resting on the slug rack near T1001. Refer to figure 7-50.

h. Zero the dial gauge.

i. Select the "GDBB" position (3.75 megacycles). The dial gauge should read 0.798 inch; if not, adjust the trimmer capacitor of T1001 until the slug rack moves to this position.

j. Check motor B102 to see that it is not hitting against an end stop.

k. Select the "BKBB" position (2.0 megacycles).

l. Adjust the slug of T1001 for zero reading on the dial gauge.

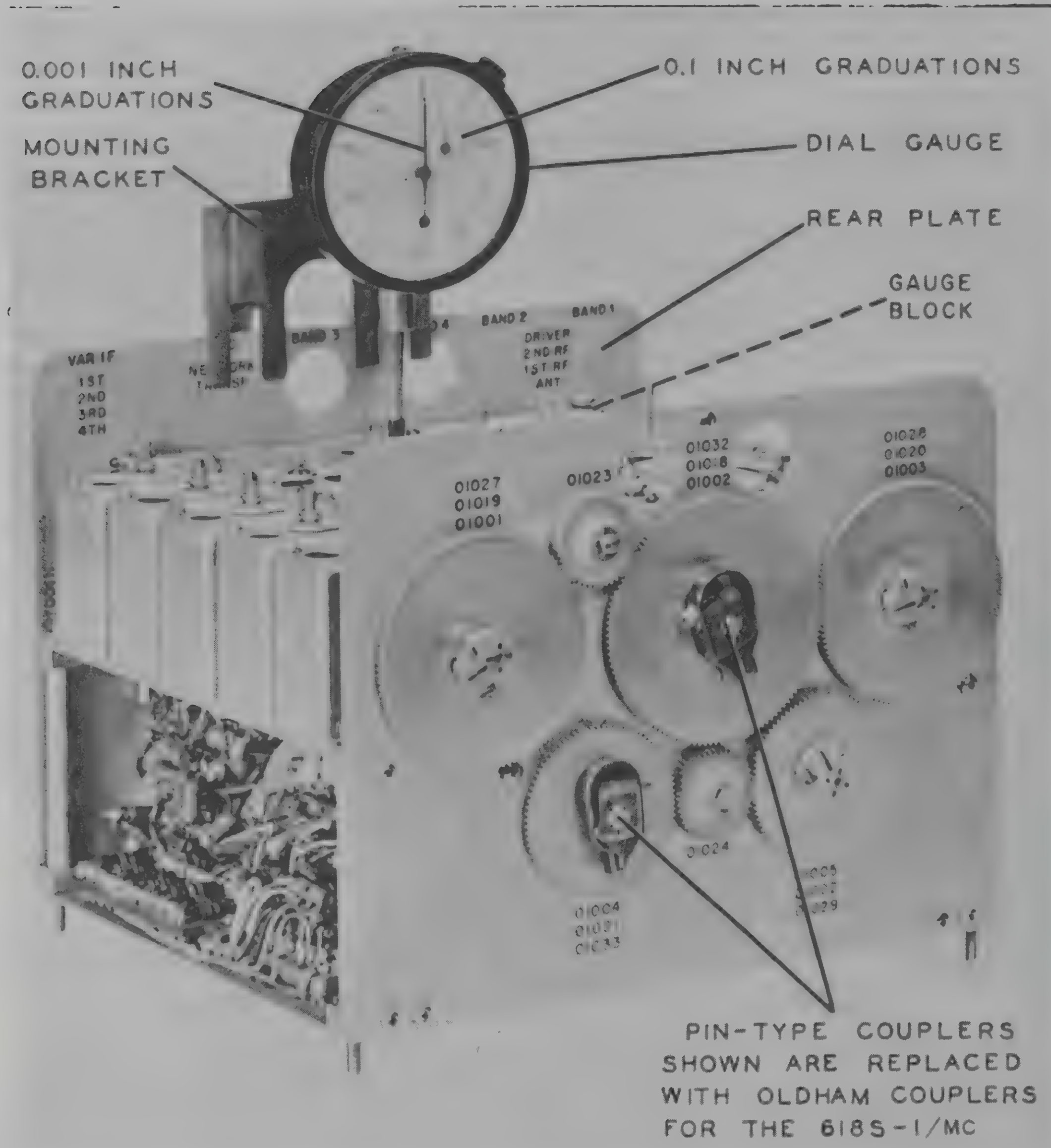


Figure 7–50. Tuner Subassembly, Dial Gauge in Place

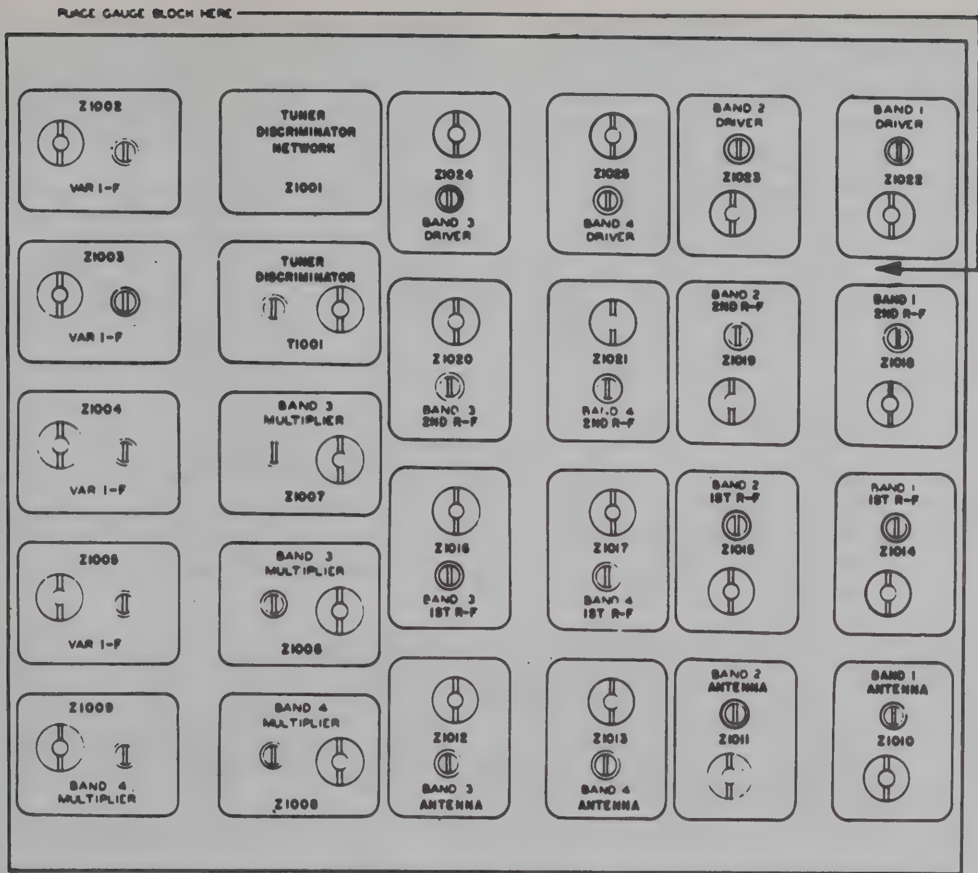


Figure 7-51. Tuner Subassembly, Electrical Alinement Points

m. Repeat the procedure outlined in steps h through l until the readings are 0.000 ±0.0005 inch at the "BKBB" position and 0.798 ±0.0005 inch at the "GDBB" position.

n. Check the slug rack linearity at the band 1 frequencies listed in figure 7-52. In each case the dial gauge reading should be within 0.004 inch of the listed reading; if not, replace T1001.

Channel Selector Positions	Operating Frequency (MC)	Dial Gauge Reading (inch)
BKBB	2.00	0.000
CDBB	2.25	0.114
CKBB	2.50	0.228
DDBB	2.75	0.342
DKBB	3.00	0.456
FDBB	3.25	0.570
FKBB	3.50	0.684
GDBB	3.75	0.798

Figure 7-52. Tuner Subassembly, Slug Rack Linearity Measurements

7-125. Variable I-F Adjustments. After completion of the mechanical adjustments on the tuner subassembly, the variable i-f tuned circuits should be adjusted. The tuner subassembly should be returned to the main chassis, and the latter should be connected in the test bench setup. Refer to figure 7-51 for alinement point location.

a. Before applying primary power, remove tube V1003 and place a 7-pin tube socket adapter in the socket. Refer to figure 7-46.

b. Replace V1003 and apply primary power.

c. Connect VTVM TS-375/U between pin 1 of V1003 (test point F) and ground. Adjust to the 3-volt a-c scale.

d. Operate the function switch to the "AME" position and allow at least ten minutes for warmup.

e. Operate the channel selectors to the "BKBB" position (2.0 megacycles).

f. Operate the function switch to the "CW" position and depress the telegraph key or microphone push-to-talk button.

g. Adjust the slugs of Z1002, Z1003, Z1004, and Z1005 for maximum indication on the TS-375/U.

h. Operate the channel selectors to the "GDBB" position (3.75 megacycles).

i. Adjust the trimmer capacitors of Z1002, Z1003, Z1004, and Z1005 for maximum indication on the TS-375/U.

j. Repeat steps e through i until no further peaking is attainable. After completion, the TS–375/U should indicate at least 1 volt ac.

Note

The agc voltage applied to the variable i-f stage (V1002) should hold the voltage at pin 1 of V1003 at a reasonable level throughout the preceding steps.

7–126. Band 3 Multiplier Adjustments. Maintain the equipment setup established in the preceding paragraph throughout the following steps:

a. Connect VTVM TS–375/U to pin 7 of second transmitter mixer V1003, (test point E). Select the 3-volt a-c range.

b. Select the channel corresponding to 7.25-megacycle operation (band 3, position "NKBB").

c. Depress the telegraph key or microphone push-to-talk button.

d. Adjust the slugs of the Z1007 and Z1006 for maximum reading on the TS–375/U. Refer to figure 7–51.

e. Select the channel corresponding to 14.2495-megacycle operation (band 3, position "TCZZ").

f. Adjust the capacitors of both band 3 multipliers (Z1007 and Z1006) for maximum reading on the TS–375/U.

g. Repeat steps c through f until no further peaking is attainable. Meter readings should be not less than 2.5 volts ac.

7–127. Band 4 Multiplier Adjustments. Maintain the equipment setup of paragraph 7–125 throughout the following steps:

a. Select the channel corresponding to 14.25 megacycles (band 4, position "VKBB").

b. Depress the telegraph key or microphone push-to-talk button.

c. Adjust the slugs of the two-band 4-multiplier coils (A1009 and Z1008) for maximum indication on the TS–375/U.

d. Select the channel corresponding to 25.0-megacycle operation (band 4, position "YFYK").

e. Adjust the capacitors of the band 4 multipliers (Z1009 and Z1008) for maximum indication on the TS–375/U.

f. Repeat steps a through d until no further peaking is achievable. The meter readings should be at least 1 volt ac.

Note

The slug-adjusting screws should be approximately centered in the slug-holding nuts for the multiplier stages to be tuned to the correct harmonic. If possible, use an accurately calibrated wavemeter to check the tuning.

7–128. R-F and Driver Adjustments. Maintain the equipment in the test bench setup throughout the following procedures. The radio set control volume control should be at the maximum clockwise positions. Perform the following operations:

a. Operate the function switch to the "AME" position and allow at least 10 minutes for warmup.

b. Connect VTVM TS–375/U betwen "J001" (test point A) and ground. Adjust to the 120-volt a-c range.

c. Operate the channel selectors to the 2.0 megacycles position ("BKBB").

d. Depress the telegraph key or microphone push-to-talk button and lock in position.

e. Adjust the slugs of Z1014, Z1018, and Z1022 for maximum indication on the TS–375/U. After a peak reading is obtained, readjust the slug of Z1022 until the voltage is 70 percent of the previously obtained maximum.

f. Operate the channel selectors to the 3.7495 megacycles position ("GCMM").

g. Perform steps b through f with the exception that the trimmer capacitors should be adjusted instead of the inductors. The trimmer capacitors are adjustable through holes in the top of the indicated tuned circuits.

h. Repeat step c and steps e through g until no further peaking is attainable. The TS–375/U should read at least 65 volts ac after completion of step i.

i. Repeat the adjustments outlined in step c and steps e through h for the frequencies listed in figure 7–53. In each case, adjust the inductor of trimmer capacitor of the listed tuned circuit. Upon completion, VTVM TS–375/U should indicate at least 65 volts ac throughout all of the channels. Check several channels on each band.

Channel Selector		Operating Frequency (MC)	Tuned Circuit	Type of Adjustment
Band	Position			
2	HKBB	3.75	Z1015, A1019, Z1023	Inductor
	MCZM	7.2495	Z1015, Z1019, Z1023	Trimmer Capacitor
3	NKBB	7.25	Z1016, Z1020, Z1024	Inductor
	TCZZ	14.2495	Z1016, Z1020, Z1024	Trimmer Capictor
4	VKBB	14.25	Z1017, Z1021, Z1025	Inductor
	YFYK	25.00	Z1017, Z1021, Z1025	Trimmer Capacitor

Figure 7–53. R-F and Driver Adjustments, Bands 2, 3, and 4

7–129. Antenna Adjustments. Maintain the component in the test bench setup throughout the succeeding steps. The radio set control volume control should be set to the maximum clockwise positions. Perform the following operations:

a. Operate the function switch to the "AME" position and allow at least 10 minutes for warmup.

b. Connect VTVM TS–375/U between terminal 5 of J310 (test point 7) and ground.

c. Terminate J101 (test point 4) in 300 ohms. Output Meter TS-585B/U may be used if operated to the 300-ohm, 500-milliwat position.

d. Connect Signal Generator AN/URM-25 to J109 (test point 3).

e. Select the channel corresponding to 2.0-megacycle operation (position "BKBB").

f. Adjust the frequency of the AN/URM-25 to 2.0 megacycles, and set the output level to approximately 3000 microvolts. Use Frequency Meter AN/USM-26 to set the AN/URM-25 frequency.

g. Adjust the band 1 antenna coil slug for maximum avc voltage. Refer to figure 7-51, Z1010.

h. Select the channel corresponding to 3.7495-megacycle operation (position "GCMM"), and change the AN/URM-25 frequency to 3.4795 mc. Maintain the AN/URM-25 output level at approximately 3000 microvolts.

i. Adjust the band 1 antenna trimmer capacitor for maximum avc voltage. Refer to figure 7-51, Z1010.

j. Repeat the procedures outlined in step a through i for the low and high end points of bands 2, 3, and 4, using 25.0 mc as the high end point on band 4. Figure 7-53 lists the proper positions and frequencies. Refer to figure 7-51, Z1011, Z1012, and Z1013.

7-130. Deleted.

Figure 7-54. Selection of R1006 (Deleted)

Figure 7-55. Tuner Subassembly, Front Oblique View, Lubrication Points

Figure 7–56. Tuner Subassembly, Rear Oblique View, Lubrication Points

7–131. LUBRICATION. The tuner subassembly should be inspected at 1000-hour intervals. If the tuning mechanism parts appear to be clean, sufficiently lubricated, and free-running, lubrication can be omitted until the next lubrication period. If old lubricant has become hard and grimy, clean the parts to be lubricated with Stoddard solvent and dry with compressed air.

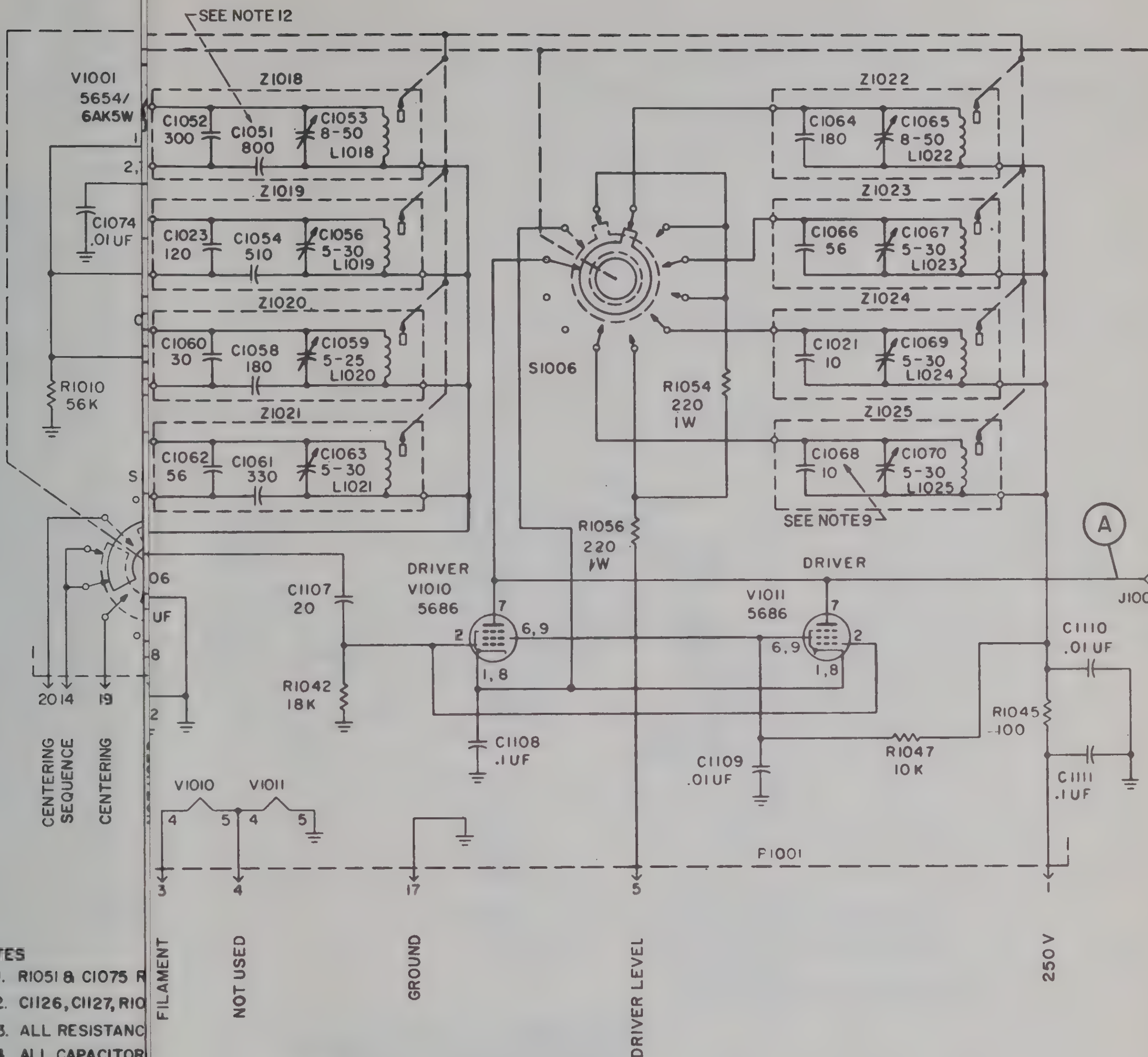
CAUTION

Do not operate the equipment until lubrication procedures have been performed or damage to the gears may result.

7–132. When required, all gears and porous bearings are to be lubricated as indicated in figures 7–55 and 7–56. Type MIL-G-23827A lubricant is to be applied to all gears (reference number 7) by means of a brush and MIL–L–7870 lubricant is to be applied to the porous bearings (reference number 8) by means of an eye dropper, or similar tool. Do not apply more lubricant than required to lightly coat the gear surfaces.

7–133. DETAILED CIRCUIT ANALYSIS. The tuner subassembly contains circuits that are common to both the receiver and transmit functions, and circuits that are used separately in order to perform the transmit or receive functions. Therefore, the explanation that follows is based on the operation of the individual circuits of the subassembly.

7–134. First Transmitter Mixer. (See figure 7–58.) The 1.75-to 3.5-mc signal from V3308 is applied to the suppressor grid of V1004 (a type 5750 pentagrid converter tube) and mixed with the 250-kc signal from V1408 in the modulator subassembly. The latter signal is connected to the control grid and is derived from the 1-mc reference standard located in the reference oscillator subassembly (see paragraph 7–112). The sum frequency (2 to 3.75 mc) is selected by the plate tuned circuit A1002 which is tuned to the selected frequency by the drive motor B102. Operation of B102 is controlled by the tuner servo amplifier and discriminator (V1001 stage) circuits, as described in paragraph 7–157 and 7–147. Output of the first transmitter mixer stage is capacitively coupled to the control grid of V1002 by means of C1012. The cathode of V1004 is grounded by means of a set of contacts on K1502 and K804 to permit conduction through the tube during transmission and opened to ground to prevent conduction during reception.



NOTES

1. R1051 & C1075 R
2. C1126, C1127, R10
3. ALL RESISTANC
4. ALL CAPACITOR
5. SELECTED RES
6. VALUE OF R102
7. VALUE OF C101
MOD 3 & 5 RESP

Figure 7–57. Tuner Subassembly, Schematic Diagram

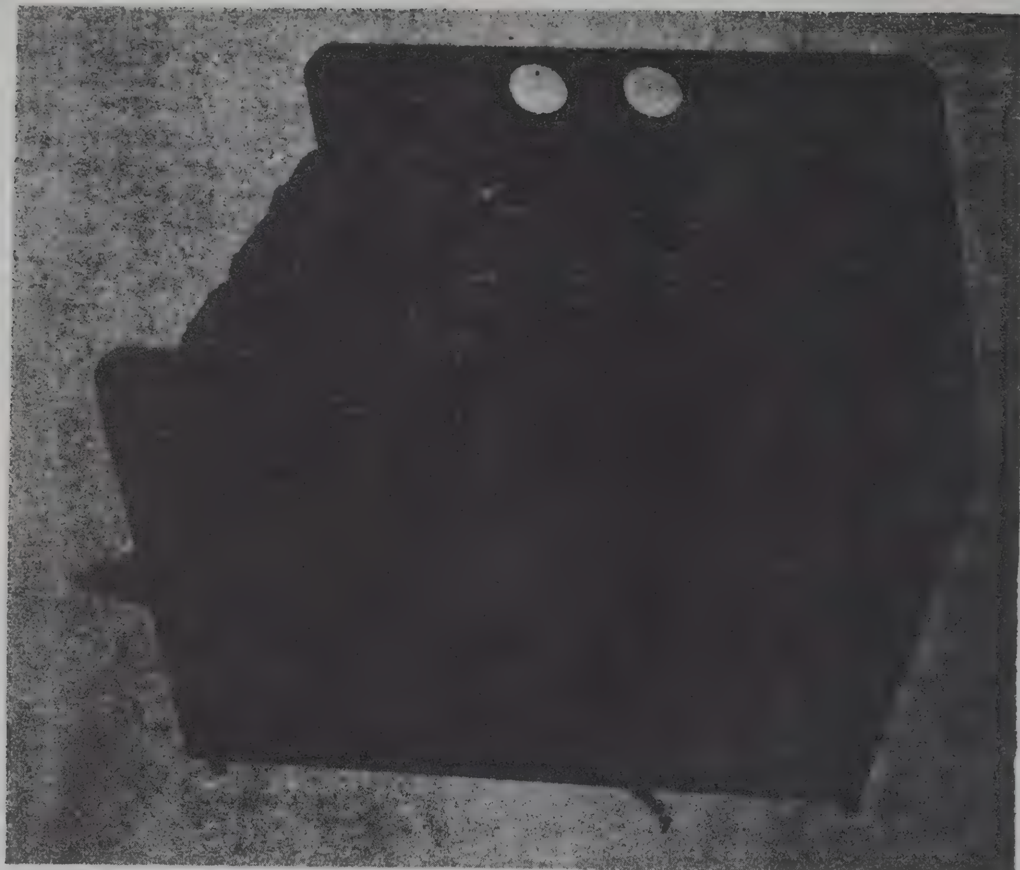


Figure 7–56. Tuner Subassembly, Rear Oblique View, Lubrication Points

7–131. LUBRICATION. The tuner subassembly should be inspected at 1000-hour intervals. If the tuning mechanism parts appear to be clean, sufficiently lubricated, and free-running, lubrication can be omitted until the next lubrication period. If old lubricant has become hard and grimy, clean the parts to be lubricated with Stoddard solvent and dry with compressed air.

CAUTION

Do not operate the equipment until lubrication procedures have been performed or damage to the gears may result.

7–132. When required, all gears and porous bearings are to be lubricated as indicated in figures 7–55 and 7–56. Type MIL-G-23827A lubricant is to be applied to all gears (reference number 7) by means of a brush and MIL–L–7870 lubricant is to be applied to the porous bearings (reference number 8) by means of an eye dropper, or similar tool. Do not apply more lubricant than required to lightly coat the gear surfaces.

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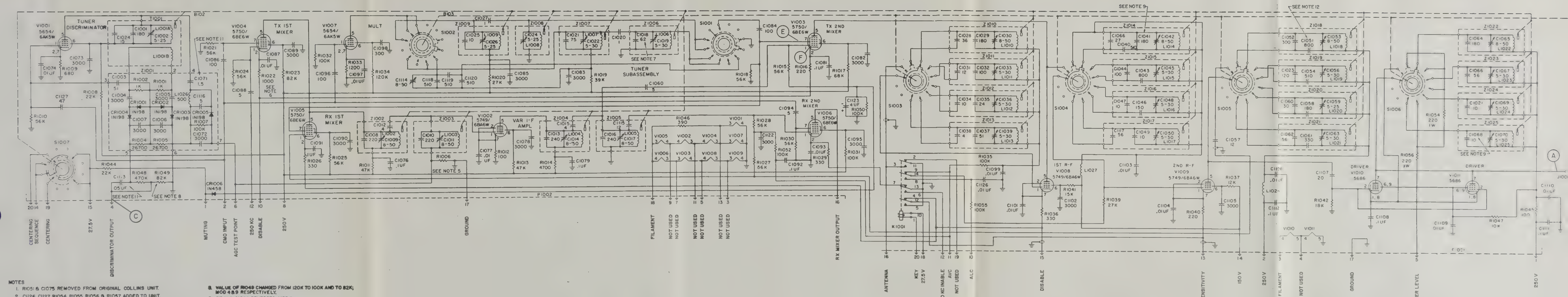
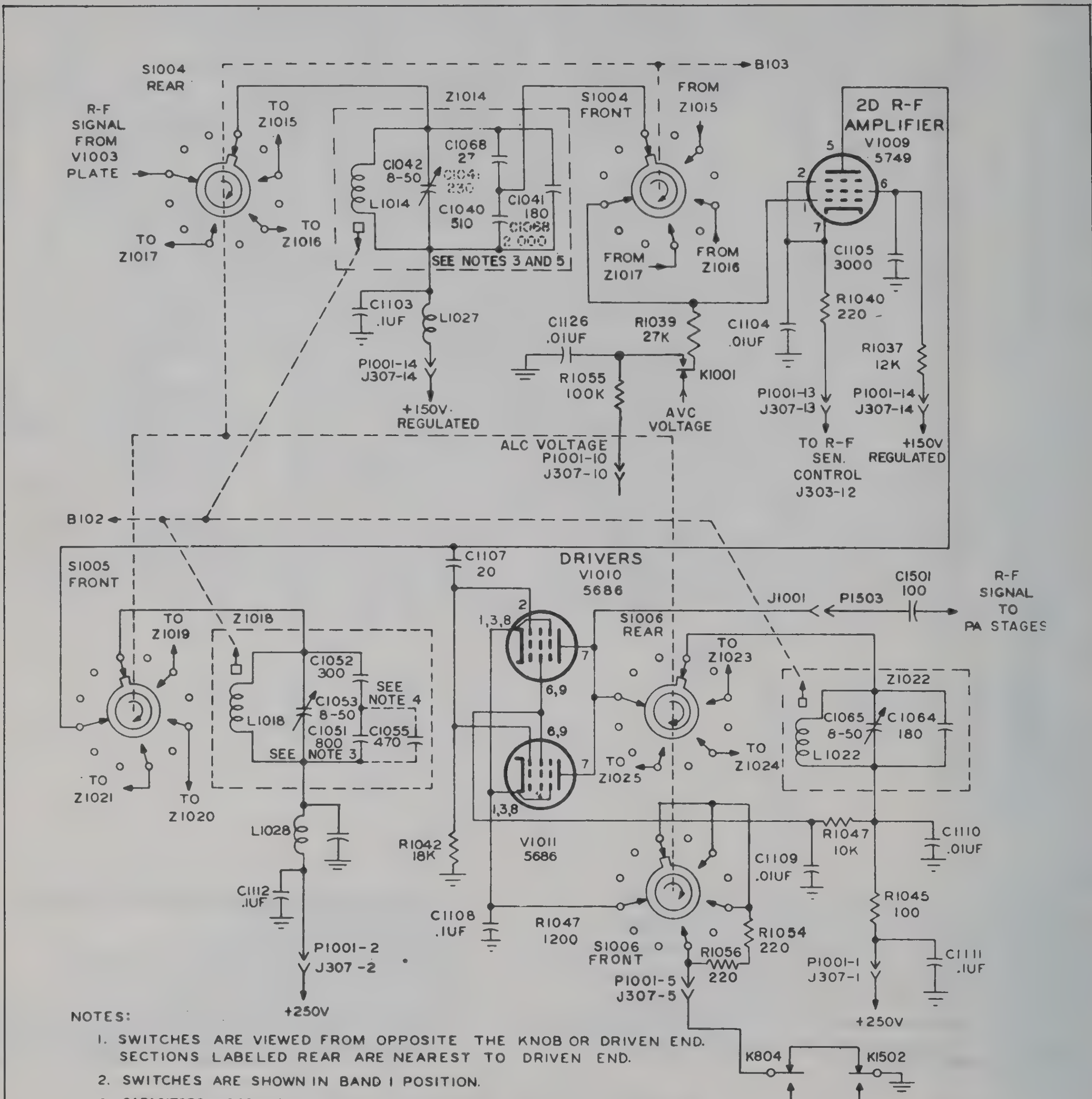


NOTES

1. R1051 & C1075 REMOVED FROM ORIGINAL COLLINS UNIT.
2. C1126, C1127, R1054, R1055, R1056 & R1057 ADDED TO UNIT.
3. ALL RESISTANCE VALUES ARE IN OHMS UNLESS OTHERWISE INDICATED.
4. ALL CAPACITORS ARE IN UUF UNLESS OTHERWISE INDICATED.
5. SELECTED RESISTOR; REFER TO T.O. 12R2-4-6-4 FOR VALUE.
6. VALUE OF R1022 CHANGED FROM 2200 TO 1000; MOD 8 OF TUNER.
7. VALUE OF C1018 CHANGED FROM 62 TO 75 AND BACK TO 62; MOD 3 & 5 RESPECTIVELY.
8. VALUE OF R1049 CHANGED FROM 120K TO 100K AND TO 82K; MOD 4 & 9 RESPECTIVELY.
9. C1041 & C1068 REVERSED; MOD 3.
10. VALUE OF C1113 CHANGED FROM 0.1 TO 0.05; MOD 9.
11. VALUE OF C1071 CHANGED FROM 1 TO 1.5; MOD 6.
12. C1012, C1015, C1019, C1022, C1023, C1032, C1033, C1036, C1039, C1044, C1045, C1048, C1050, C1051, C1056, C1060, C1063, C1067, C1069 & C1070 WERE 7, 7, 5-25, 5-25, 100, 82, 8-50, 5-25, 5-25, 100, 8-50, 5-25, 5-25, 470, 8-50, 24, 5-25, 8-50, 5-25 & 5-25 RESPECTIVELY FOR MOD 1 & 2.

Figure 7–57. Tuner Subassembly, Schematic Diagram



NOTES:

1. SWITCHES ARE VIEWED FROM OPPOSITE THE KNOB OR DRIVEN END. SECTIONS LABELED REAR ARE NEAREST TO DRIVEN END.
2. SWITCHES ARE SHOWN IN BAND I POSITION.
3. CAPACITORS C1040, C1041, C1068, AND C1051 CHANGED FROM 2000, 220, 2000, AND 470 TO 510, 180. 27, 800 MOD 3.
4. CAPACITOR C1055 DELETED FROM Z1018 AND ADDED TO Z1025 MOD 3.
5. CAPACITORS C1041 AND C1068 REVERSED MOD 3.

Figure 7–61. Second R-F Amplifiers and Drivers, Simplified Schematic Diagram

7–135. Variable I-F Amplifier. As shown in figure 7–59, the variable i-f amplifier stage, V1002, employs a 5749 pentode tube to amplify the 2-to 3.75-mc signal produced in the first transmitter mixer. Two tuned circuits, Z1003 and Z1004, are used to resonate the grid and plate circuits to the particular frequency selected. Resistor R1006, connected in series with the grid tuned circuit, is selected by factory experimentation for optimum results, and will differ in value with individual equipments. Cathode bias is supplied by capacitor C1077 and resistor R1012. The output is capacitively coupled through C1015 to the second transmitter mixer, V1003.

7–136. Second Transmitter Mixer and Multiplier. The 2-to 3.75-mc signal from the variable i-f amplifier is developed across tuned circuit Z1005 and applied to the control grid of the second transmitter mixer V1003 as shown in figure 7–60. An injection voltage from the multiplier stage and associated tuned circuits is applied to grid three of V1003. The basic master oscillator output frequency (1.75 to 3.5 mc) is applied through coupling capacitor C1096 to the control grid of multiplier V1007. The plate circuit of V1007 connects through switch S1002 to one of three tuned circuits, depending upon the band of operation. Switch S1002 is illustrated in the band 1 position in which no tuned circuit is used. Therefore, the plate of V1007 is open and the tube is nonconducting. Band 1 frequencies correspond directly to the desired output frequencies following the first heterodyning described previously and therefore require no second heterodyning in the second transmitter mixer. In band 2, Z1007 is shunted by the capacitance combination of C1114, C1118, C1119, and C1120, thereby resonating Z1007 to the master oscillator fundamental frequency (1.75 to 3.5 mc). Band 2 injection voltage to V1003 is taken between capacitors C1119 and C1120. When switches S1002 and S1001 rear are operated to the band 3 position, tuned circuits Z1007 and A1006 provide the load impedance between V1007 and V1003. The capacitor combination of C1114, C1118, C1119, and C1120 is not shunted across Z1007 in the band 3 position, thus raising the resonant frequency range through which Z1007 is tunable. The combination of Z1007 and Z1006 selects the third harmonic of the master oscillator output for band 3. Thus, an injection voltage within the range of 5.25 to 10.5 mc is supplied to V1003. Tuned circuits Z1008 and Z1009, which are not shown in figure 7–60, are used in the band 4 position to select the seventh harmonic (12.25 to 21.656 mc) of the master oscillator output. Note that the seventh harmonic of the highest master oscillator frequency (3.5 mc) is a higher frequency than the 21.656 mc selected by Z1008 and Z1009. However, 21.656 mc is the highest usable frequency, since a final frequency of 25 mc is desired after second heterodyning in V1003. The two largest frequencies heterodyned in V1003 are the 21.656-mc signal, and a 3.344-mc signal from the master oscillator and first transmitter mixer, V1004, thus producing the desired 25-mc maximum frequency.

7–137. Another injection voltage, which is applied to the control grid of V1003, originates in the tuner muting circuit. The tuner muting circuit consists of resistors R1044 and R1050, capacitor C1123, and crystal rectifier CR1006. A fixed bias of 27.5 volts dc is applied to CR1006 at all times. Under normal conditions, CR1006 cannot deduct because of the bias voltage. During channeling, a signal from V602 located in the tuner servo amplifier subassembly is applied across CR1006. This signal is sufficient to overcome the bias, causing CR1006 to conduct through the parallel combination of C1123 and R1050. The resultant negative voltage drop is sufficient to bias the control grid of V1003 to cutoff. The signal from V602 is applied across CR1006 only during the channeling cycle of the tuner subassembly, thus preventing V1003 from conducting. Automatic Antenna Tuner 180L-3 depends for its operation upon a signal from the tuner subassembly. Since V1003 is cut off during the channeling cycle of the tuner subassembly, the antenna tuner cannot operate until the cycle is complete. This prevents spurious radiation and the possibility of the antenna being tuned to an incorrect frequency.

7–138. Two signals are present at the second transmitter mixer, V1003, disregarding the muting signal, which is present only during part of the channeling cycle. One signal from the main signal line is applied to the control grid of V1003. The second signal, from the multiplier circuits, is applied to the suppressor grid of V1003. A heterodyning action takes place within the electron stream producing outputs as determined by the band of operation. Figure 7–61 illustrates the plate tuned circuit (Z1014) which is used for band 1 operation. Tuned circuits Z1015, Z1016, and Z1017, which are used for bands 2, 3, and 4, respectively, are not shown as they are identical in design with only the values of the parts changed. These tuned circuits are selected by switch S1004 rear, depending upon the band of operation, and are tuned depending upon information provided by the tuner servo amplifier circuits. Input and output frequencies for V1003 are listed in the table of figure 7–62.

Band	Main Signal Line (MC) (Grid 1)	Multiplier Circuits (MC) (Grid 3)	Plate Tuned Circuit	Selected Frequency (MC)
1	2 to 3.7495	Zero	Z1014	2 to 3.7495
2	2 to 3.7475	1.75 to 3.5	Z1015	3.75 to 7.2495
3	2 to 3.749875	5.25 to 10.5	Z1016	7.25 to 14.2495
4	2 to 3.34375	12.25 to 21.65625	Z1017	12.25 to 25

Figure 7–62. Second Mixer Transmitter Frequencies

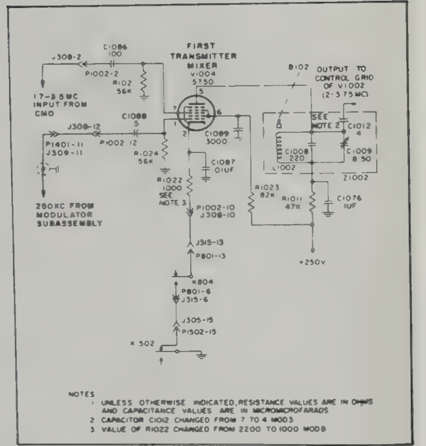


Figure 7–58. First Transmitter Mixer, Simplified Schematic Diagram

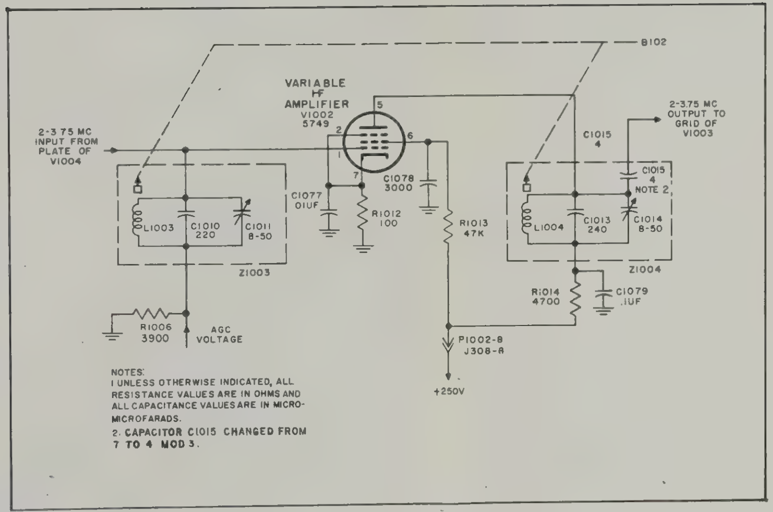


Figure 7–59. Variable I-F Amplifier, Simplified Schematic Diagram

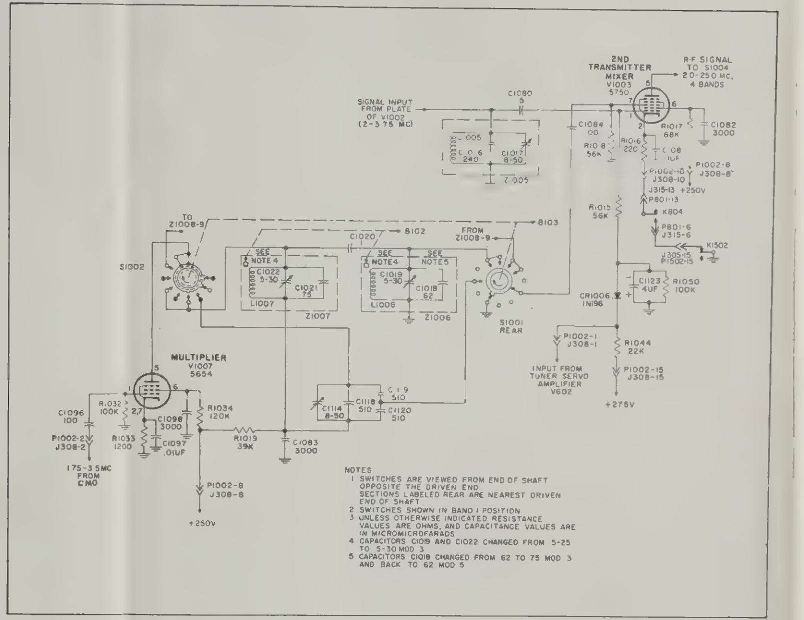


Figure 7–60. Second Transmitter Mixer and Multiplier, Simplified Schematic Diagram

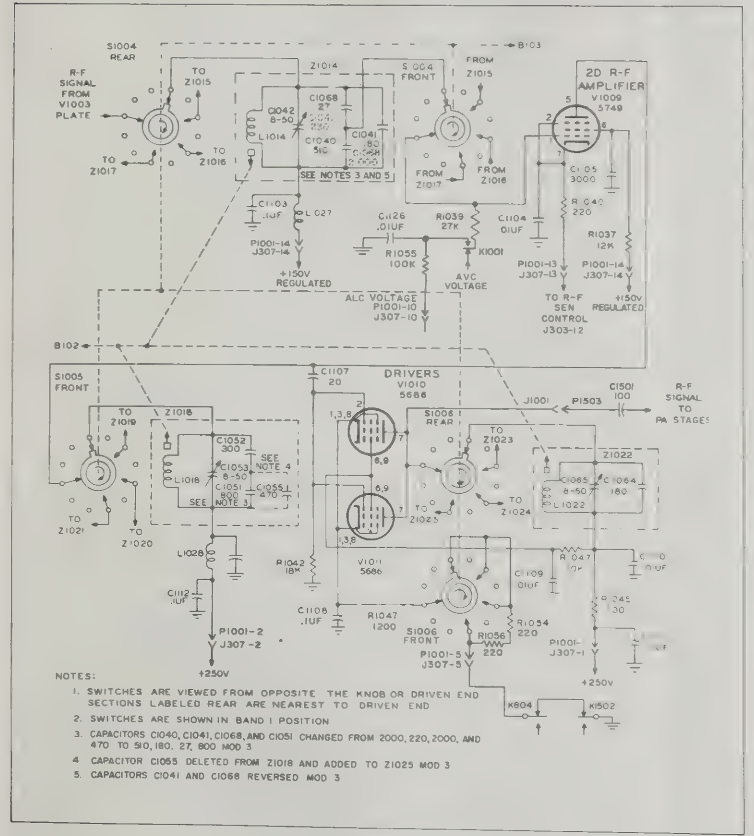


Figure 7–61. Second R-F Amplifiers and Drivers, Simplified Schematic Diagram

7-135. Variable I-F Amplifier. As shown in figure 7-59, the variable i-f amplifier stage, V1002, employs a 5749 pentode tube to amplify the 2-to 3.75-mc signal produced in the first transmitter mixer. Two tuned circuits, Z1003 and Z1004, are used to resonate the grid and plate circuits to the particular frequency selected. Resistor R1006, connected in series with the grid tuned circuit, is selected by factory experimentation for optimum results, and will differ in value with individual equipments. Cathode bias is supplied by capacitor C1077 and resistor R1012. The output is capacitively coupled through C1015 to the second transmitter mixer, V1003.

7-136. Second Transmitter Mixer and Multiplier. The 2-to 3.75-mc signal from the variable i-f amplifier is developed across tuned circuit Z1005 and applied to the control grid of the second transmitter mixer V1003 as shown in figure 7-60. An injection voltage from the multiplier stage and associated tuned circuits is applied to grid three of V1003. The basic master oscillator output frequency (1.75 to 3.5 mc) is applied through coupling capacitor C1096 to the control grid of multiplier V1007. The plate circuit of V1007 connects through switch S1002 to one of three tuned circuits, depending upon the band of operation. Switch S1002 is illustrated in the band 1 position in which no tuned circuit is used. Therefore, the plate of V1007 is open and the tube is nonconducting. Band 1 frequencies correspond directly to the desired output frequencies following the first heterodyning described previously and therefore require no second heterodyning in the second transmitter mixer. In band 2, Z1007 is shunted by the capacitance combination of C1114, C1118, C1119, and C1120, thereby resonating Z1007 to the master oscillator fundamental frequency (1.75 to 3.5 mc). Band 2 injection voltage to V1003 is taken between capacitors C1119 and C1120. When switches S1002 and S1001 rear are operated to the band 3 position, tuned circuits Z1007 and A1006 provide the load impedance between V1007 and V1003. The capacitor combination of C1114, C1118, C1119, and C1120 is not shunted across Z1007 in the band 3 position, thus raising the resonant frequency range through which Z1007 is tunable. The combination of Z1007 and Z1006 selects the third harmonic of the master oscillator output for band 3. Thus, an injection voltage within the range of 5.25 to 10.5 mc is supplied to V1003. Tuned circuits Z1008 and Z1009, which are not shown in figure 7-60, are used in the band 4 position to select the seventh harmonic (12.25 to 21.656 mc) of the master oscillator output. Note that the seventh harmonic of the highest master oscillator frequency (3.5 mc) is a higher frequency than the 21.656 mc selected by Z1008 and Z1009. However, 21.656 mc is the highest usable frequency, since a final frequency of 25 mc is desired after second heterodyning in V1003. The two largest frequencies heterodyned in V1003 are the 21.656-mc signal, and a 3.344-mc signal from the master oscillator and first transmitter mixer, V1004, thus producing the desired 25-mc maximum frequency.

7-137. Another injection voltage, which is applied to the control grid of V1003, originates in the tuner muting circuit. The tuner muting circuit consists of resistors R1044 and R1050, capacitor C1123, and crystal rectifier CR1006. A fixed bias of 27.5 volts dc is applied to CR1006 at all times. Under normal conditions, CR1006 cannot deduct because of the bias voltage. During channeling, a signal from V602 located in the tuner servo amplifier subassembly is applied across CR1006. This signal is sufficient to overcome the bias, causing CR1006 to conduct through the parallel combination of C1123 and R1050. The resultant negative voltage drop is sufficient to bias the control grid of V1003 to cutoff. The signal from V602 is applied across CR1006 only during the channeling cycle of the tuner subassembly, thus preventing V1003 from conducting. Automatic Antenna Tuner 180L-3 depends for its operation upon a signal from the tuner subassembly. Since V1003 is cut off during the channeling cycle of the tuner subassembly, the antenna tuner cannot operate until the cycle is complete. This prevents spurious radiation and the possibility of the antenna being tuned to an incorrect frequency.

7-138. Two signals are present at the second transmitter mixer, V1003, disregarding the muting signal, which is present only during part of the channeling cycle. One signal from the main signal line is applied to the control grid of V1003. The second signal, from the multiplier circuits, is applied to the suppressor grid of V1003. A heterodyning action takes place within the electron stream producing outputs as determined by the band of operation. Figure 7-61 illustrates the plate tuned circuit (Z1014) which is used for band 1 operation. Tuned circuits Z1015, Z1016, and Z1017, which are used for bands 2, 3, and 4, respectively, are not shown as they are identical in design with only the values of the parts changed. These tuned circuits are selected by switch S1004 rear, depending upon the band of operation, and are tuned depending upon information provided by the tuner servo amplifier circuits. Input and output frequencies for V1003 are listed in the table of figure 7-62.

Band	Main Signal Line (MC) (Grid 1)	Multiplier Circuits (MC) (Grid 3)	Plate Tuned Circuit	Selected Frequency (MC)
1	2 to 3.7495	Zero	Z1014	2 to 3.7495
2	2 to 3.7475	1.75 to 3.5	Z1015	3.75 to 7.2495
3	2 to 3.749875	5.25 to 10.5	Z1016	7.25 to 14.2495
4	2 to 3.34375	12.25 to 21.65625	Z1017	12.25 to 25

Figure 7-62. Second Mixer Transmitter Frequencies

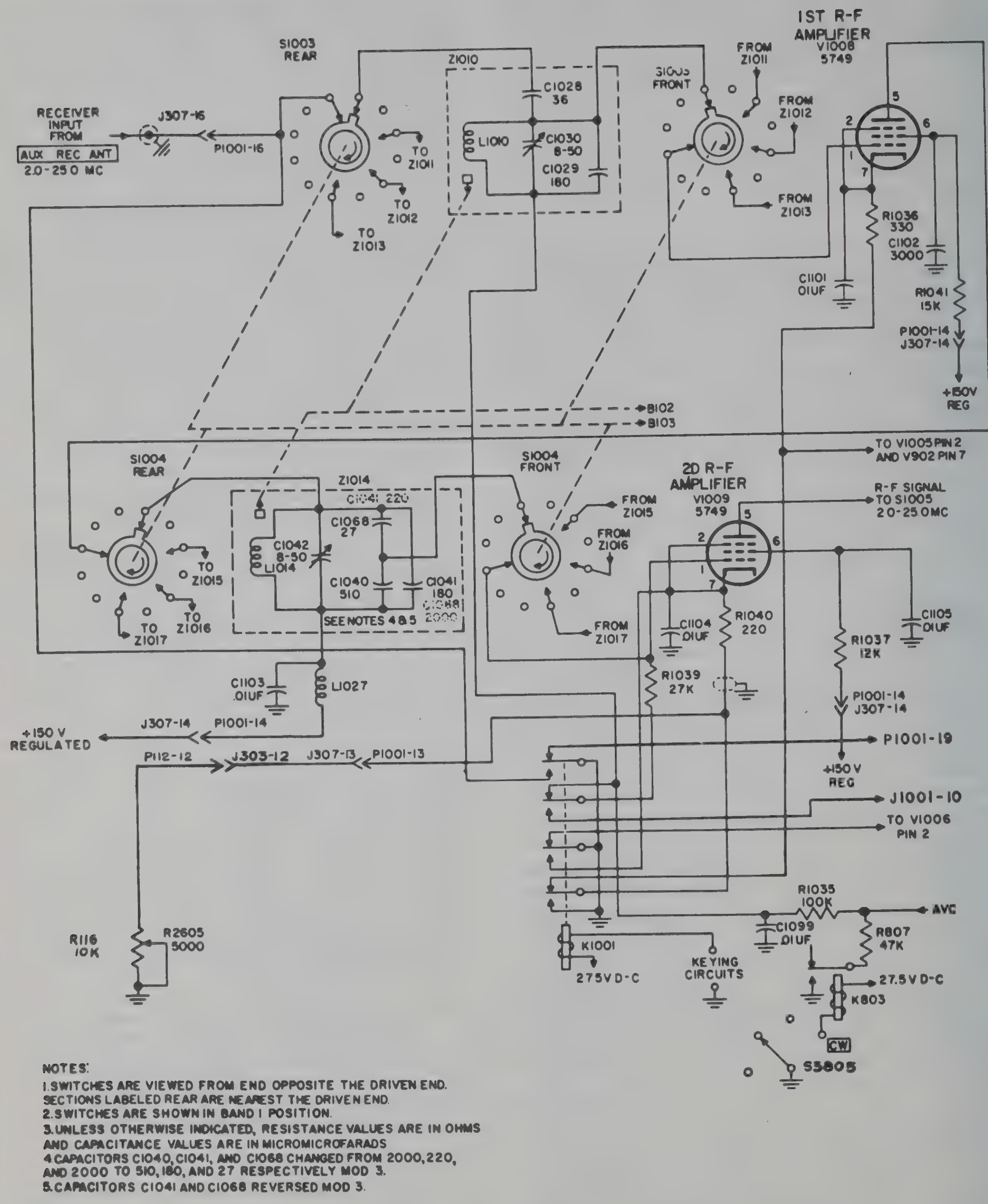


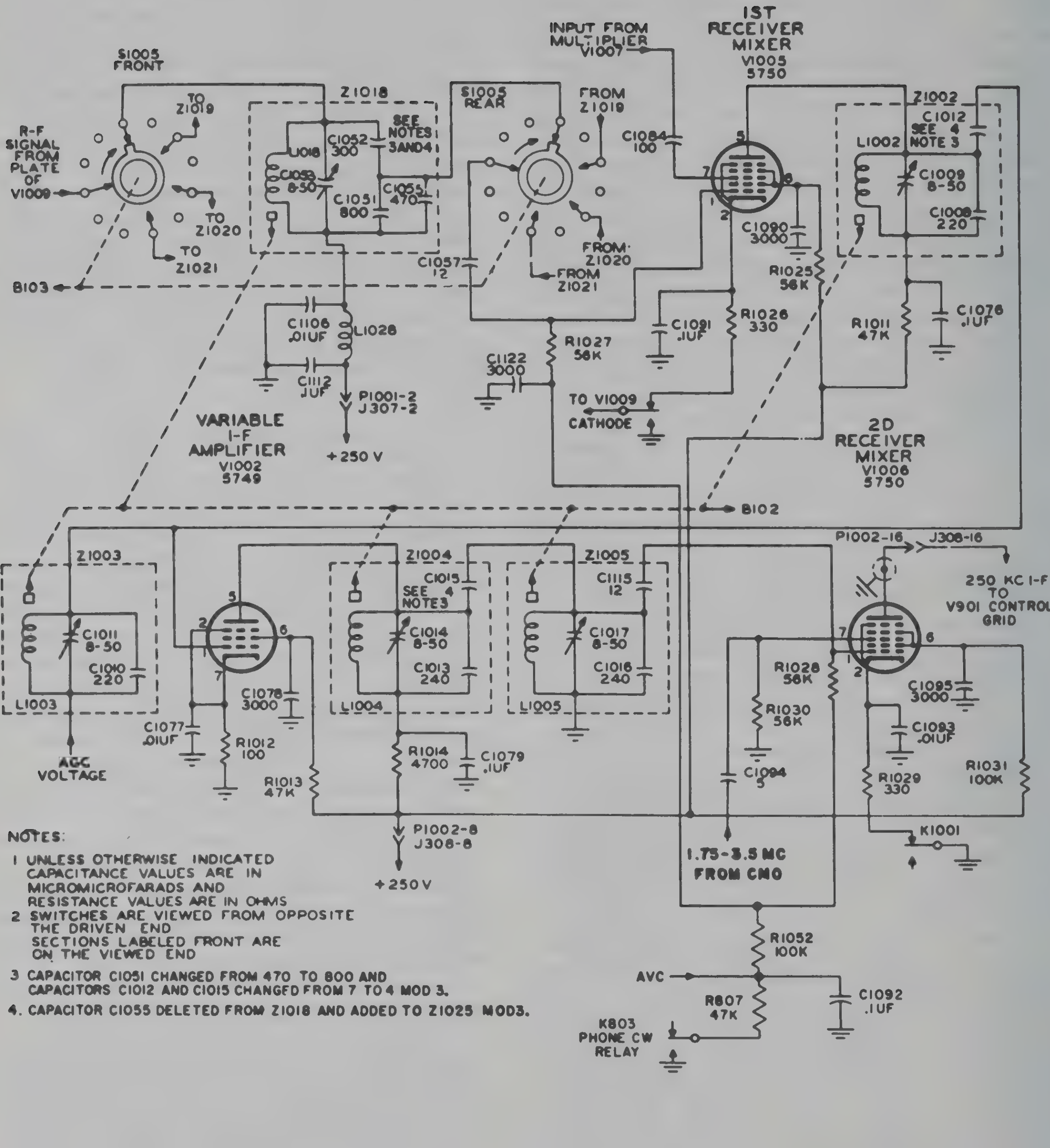
Figure 7–63. Receiver R-F Amplifiers, Simplified Schematic Diagram

7–139. Second R-F and Driver Assembly. The signal from the V1003 plate circuit is applied through S1004 rear and across tuned circuit Z1014, Z1015, Z1016, or Z1017 as explained previously and as shown in figure 7–61. Switch S1004 front connects the selected tuned circuit to the grid of the second r-f amplifier V1009. Contacts on relay K1001 ground the cathode of V1009 and the lower side of R1039 when the transmitter is keyed. This increases the r-f gain slightly during transmission. The r-f signal as listed in figure 7–62 is amplified by V1009 and coupled by means of one of four plate tuned circuits (depending upon the band of operation) to the parallel connected grids of the driver-amplifiers, V1010 and V1011. Tuned circuits Z1019, Z1020, and Z1021 (not shown in figure 7–61) are used when operating in bands 2, 3, and 4, respectively. Tuned circuit Z1018 is the only plate tuned circuit illustrated for the sake of simplicity. This circuit is used in band 1. (Switch S1005 rear, which is not shown in figure 7–61, is used when the transmitter is in the key-up mode as will be explained in paragraph 7–146.) The r-f signal is developed across tuned circuit Z1018 and applied through coupling capacitor C1107 to the control grids of the driver tubes V1010 and V1011. The driver stages consist of two 5686 tubes connected in parallel. The common point of the two cathodes is connected through contacts of switch S1006, rear, through resistors R1043, R1054, and R1056, and contacts on relays K804 and K1502 to ground. Resistors R1054 and R1056 in conjunction with capacitor C1108, provides cathode bias for the driver tubes. In the band 4 position, R1054 and C1108 are not used and the cathodes are conected through R1056 to ground. This raises the gain slightly at the higher frequencies to prevent a decreased power output when operating in band 4. The r-f signal is amplified and applied across tuned circuit Z1022 for band 1 (Z1023, Z1024, and Z1025 for bands 2, 3, and 4, respectively) which resonates to the particular frequency selected. Output of V1010 and V1011 is coupled through capacitor C1501 to the parallel connected control grids of the power amplifier tubes, V1501, V1502, and V1503.

7–140. Receiver R-F Amplifiers. As noted in figure 7–63, the incoming r-f signal from the front panel "AUX REC ANT" jack is applied through contacts of S1003, rear, through coupling capacitor C1028, and developed across tuned circuit Z1010. The r-f input signal is grounded through contacts of relay K1001 when the transmitter is keyed in order to prevent reception when a transmission is in progress. Tuned circuit Z1010 is used on band 1 (2 to 3.75 mc). Tuned circuits Z1011 through Z1013 (not shown) are used for bands 2 (3.75 to 7.25 mc), 3 (7.25 to 14.25 mc) and 4 (14.25 to 25 mc), respectively. The signal is applied through Z1010, which resonates to a particular band 1 frequency, through contacts of S1003, front, and applied to the control grid of V1008. The cathode of V1008 connects to the cathode of V1009 when the transmitter is not keyed. When keyed, the first r-f amplifier (V1008) is removed from the circuit by a set of contacts on relay K1001. The received r-f signal is amplified, fed through contacts of S1004, rear, and developed across tuned circuit Z1014. Tuned circuits Z1015 through Z1017 (not shown) are selected by S1004, rear, for bands 2, 3, and 4, respectively. Capacitors C1068 and C1040 form an r-f voltage divider for the signal applied to the grid of the second r-f amplifier, V1009. The r-f signal is coupled through contacts of S1004, front, and developed across grid resistor R1039. Avc voltage is supplied directly to V1008, and through the contacts of K1001 to V1009. When receiving in the cw mode, the avc is grounded through resistor R807, thereby lowering the avc voltage and increasing the gain of V1008 and V1009. When keyed, the cathode circuit of V1009 is grounded through contacts of K1001, to further increase the gain of V1009. Alc bias is applied through R1039 to control the gain of V1009. The r-f signal is amplified by V1009 and applied through contacts of S1005, front and rear, to the control grid of the receiver first mixer stage, V1005.

7–141. Receiver Mixers and Variable I-F Amplifier. As shown in figure 7–64, the r-f signal from the plate of V1009 is applied through contacts of S1005, front, through tuned circuit Z1018 (Z1019 through Z1021 for bands 2, 3, and 4, respectively), through contacts of S1005, rear, and coupling capacitor C1057, to the grid of V1005. The grid resistor, R1027, is returned to the avc bus by means of the filter network consisting of R1052 and C1122. The avc is grounded through R807 and contacts on K803 when in the "CW" position. The cathode circuit of V1005 is connected through contacts on K1001 to open the circuit when the transmitter is keyed. An injection signal from the multiplier is applied through coupling capacitor C1084 to grid 3 of V1005. Figure 7–65 shows the multiplier circuit in the band 2 position. A 1.75-to 3.5 mc signal, which originates in the channelizer, is amplified by V1007, and the first, third, or seventh harmonic selected by combinations of tuned circuits. Tuned circuits Z1006 and Z1007, in conjunction with capacitors C1114, C1118, C1119, and C1120 select the first harmonic (1.75 to 3.5 mc) for band 2. In band 3, the shunt capacitors are not used and tuned circuits Z1006 and Z1007 resonate at the third harmonic (5.25 to 10.5 mc). Tuned circuits Z1008 and Z1009 (not shown) select the seventh harmonic (12.25 to 21.656 mc) when in the band 4 position. The multiplier signal is not used on band 1, as the frequencies involved correspond directly to the variable i-f frequency (2 to 3.75 mc) and no first heterodyning is required.

7–142. The injection signal is coupled through capacitor C1084 to grid 3 of the first receiver mixer, V1005. The two signals (one of 2 to 25 mc from the main signal source and the other of 0 to 21.56 mc from the multiplier circuits) are heterodyned within



NOTES:

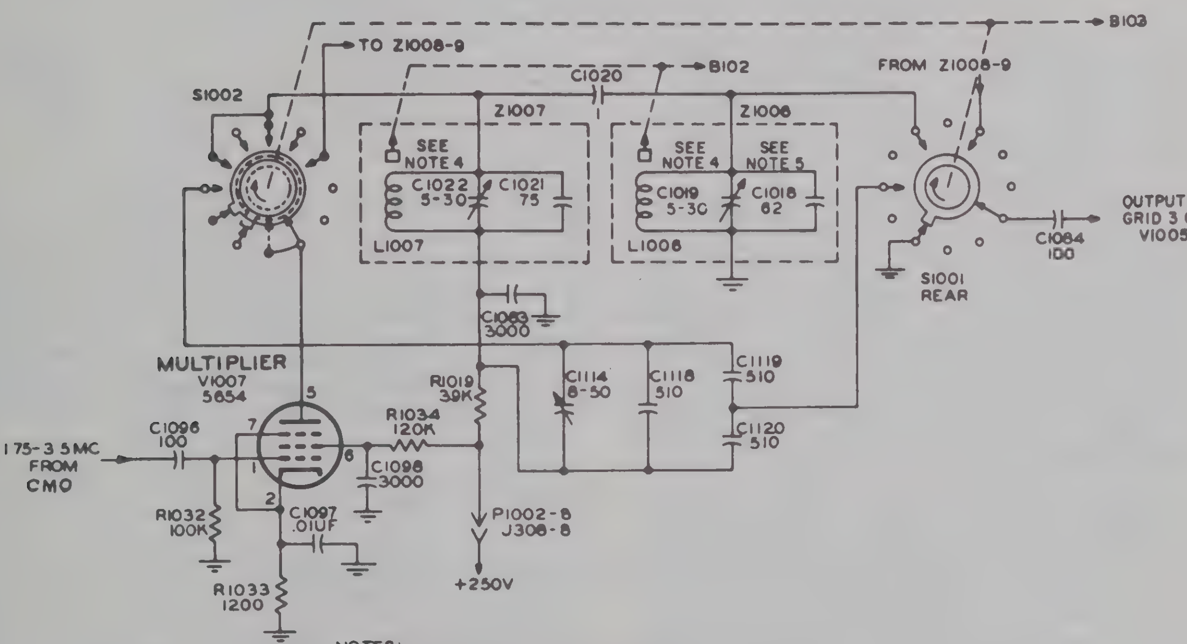
1 UNLESS OTHERWISE INDICATED CAPACITANCE VALUES ARE IN MICROMICROFARADS AND RESISTANCE VALUES ARE IN OHMS
2 SWITCHES ARE VIEWED FROM OPPOSITE THE DRIVEN END SECTIONS LABELED FRONT ARE ON THE VIEWED END
3 CAPACITOR C1051 CHANGED FROM 470 TO 800 AND CAPACITORS C1012 AND C1015 CHANGED FROM 7 TO 4 MOD 3.
4. CAPACITOR C1055 DELETED FROM Z1018 AND ADDED TO Z1025 MOD3.

Figure 7–64. Receiver Mixers and Variable I-F Amplifier, Simplified Schematic Diagram

the electron stream of V1005, and the difference frequency (2 to 3.75 mc) selected by tuned circuits Z1002 and Z1003. The 2-to 3.75-mc signal is applied to the grid of the variable i-f amplifier V1002 and developed across tuned circuits Z1004 and Z1005. The variable i-f amplifier stage, in conjunction with tuned circuits Z1002 through Z1005, is used during both transmission and reception. An agc voltage, which originates in the tuner discriminator, is applied to the control grid of V1002. This agc voltage follows the output level of the r-f oscillator. Thus, as the overall gain tries to decrease as a result of a decreased r-f oscillator output level, the gain of V1002 increases. In this manner, V1002 performs the dual functions of amplifying the variable i-f signal and maintaining a constant overall gain with a varying r-f oscillator signal level.

7–143. Output from V1002 is developed across Z1004 and Z1005 and applied to the control grid of the second receiver mixer, V1006. The cathode of V1006 is grounded through contacts of relay K1001 when in the key-up position. Relay K1001 is energized when the transmitter is keyed, opening the ground circuit, and removing the stage from operation. An injection voltage from the r-f oscillator, within the range of 1.75 to 3.5 mc, is coupled through capacitor C1094 and applied to grid 3 of V1006. A heterodyning action takes place within the electron stream of V1006, and the difference frequency selected by filter FL901 as will be described in paragraph 7–232. As a result of the heterodyning action, a fixed i-f frequency of 250 kc will be passed by the filter. Figure 7–66 lists the four bands of operation and the frequencies present at the grids and plates of the various tubes.

7–144. AGC and AVC Circuits. As shown in figure 7–67, a portion of the signal from the plate circuit of the tuner discriminator, V1001, is coupled through capacitor C1071 and developed across the tuned circuit consisting of inductor L1026 and capacitor C1116. Capacitor C1116 and inductor L1026, in conjunction with the distributed capacity, resonate at the lower and middle frequencies of the master oscillator range, thereby increasing the agc voltage throughout these frequency ranges. This is desirable to compensate for a varying master oscillator output. The signal from V1001 is rectified by CR1005 and filtered by the parallel combination of C1072, R1006, and R1007. Resistor R1006 is selected by factory experimentation



NOTES:
1. SWITCHES ARE VIEWED FROM END OF SHAFT OPPOSITE THE DRIVEN END SECTIONS LABELED REAR ARE NEAREST DRIVEN END OF SHAFT.
2. SWITCHES SHOWN IN BAND 1 POSITION.
3. UNLESS OTHERWISE INDICATED RESISTANCE VALUES ARE OHMS AND CAPACITANCE VALUES ARE IN MICROMICROFARADS
4. CAPACITORS C1019 AND C1022 CHANGED FROM 5-25 TO 5-30 MOD3.
5. CAPACTOR C1018 CHANGED FROM 62 TO 75 MOD 3 AND BACK TO 62 MOD 5.

Figure 7–65. Receiver Multiplier Circuits, Simplified Schematic Diagram

Band	Input (MC) (V1005 Grid 1)	Multiplier (MC) (V1005 Grid 3)	Variable I-F (MC) (V1006 Grid 1)	R-F Oscillator (MC) (V1006 Grid 3)	Fixed I-F (MC) (V1006 Plate)
1	2.0 to 3.75	Not used	2.0 to 3.75	1.75 to 3.5	0.25
2	3.75 to 7.25	1.75 to 3.5	2.0 to 3.75	1.75 to 3.5	0.25
3	7.25 to 14.25	5.25 to 10.5	2.0 to 3.75	1.75 to 3.5	0.25
4*	14.25 to 25.00	12.25 to 21.656	2.0 to 3.344	1.75 to 3.095	0.25

*On band 4, slugs within the tuner subassembly have a limited range movement. This necessitates the frequencies listed for the grids of V1005 and V1006.

Figure 7–66. First and Second Receiver Mixer Frequencies

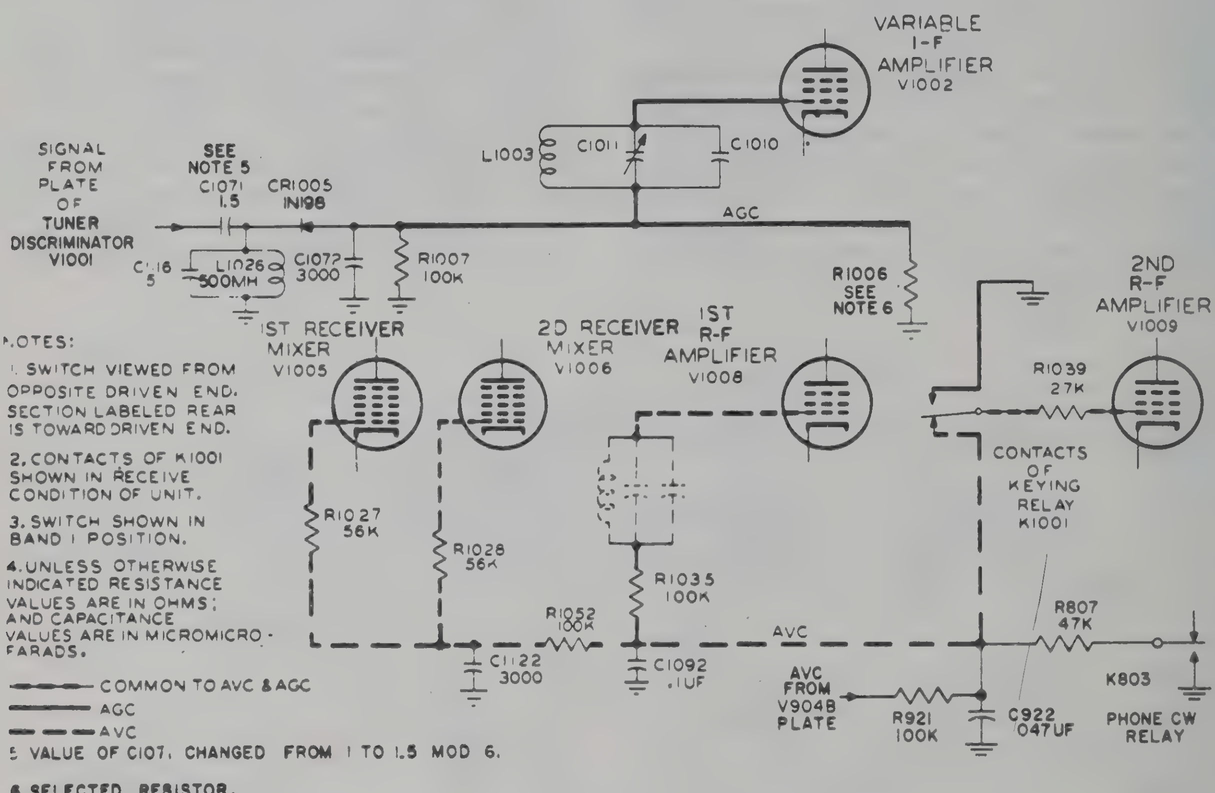


Figure 7–67. AGC and AVC Circuits, Simplified Schematic Diagram

for optimum agc voltage for each component. Agc is supplied to variable i-f amplifier V1002 during both transmission and reception, thereby compensating for a varying output level from the master oscillator stage.

7–145. Avc voltage from V904B is filtered by resistor R921 and capacitor C922 and applied through contacts of K1001 to the control grid circuit of the second r-f amplifier stage, V1009. The avc signal is grounded through resistor R807 and contacts of K803 when in the cw operating mode in order to lower the avc voltage and increase the gain when receiving cw signals. Relay K1001 is energized whenever the microphone push-to-talk button or the telegraph key is depressed. This removes the avc and grounds the grid circuit of V1004 during transmission. The avc voltage is further filtered by the low-pass filter arrangement of C1092, C1099, C1122, R1035, and R1052 for the receiver first and second mixer stages and the receiver first i-f amplifier stage. During transmission, V1005, V1006, and V1008 are removed from operation by operation of K1001 which opens the cathode circuits of these tubes to ground, as described previously.

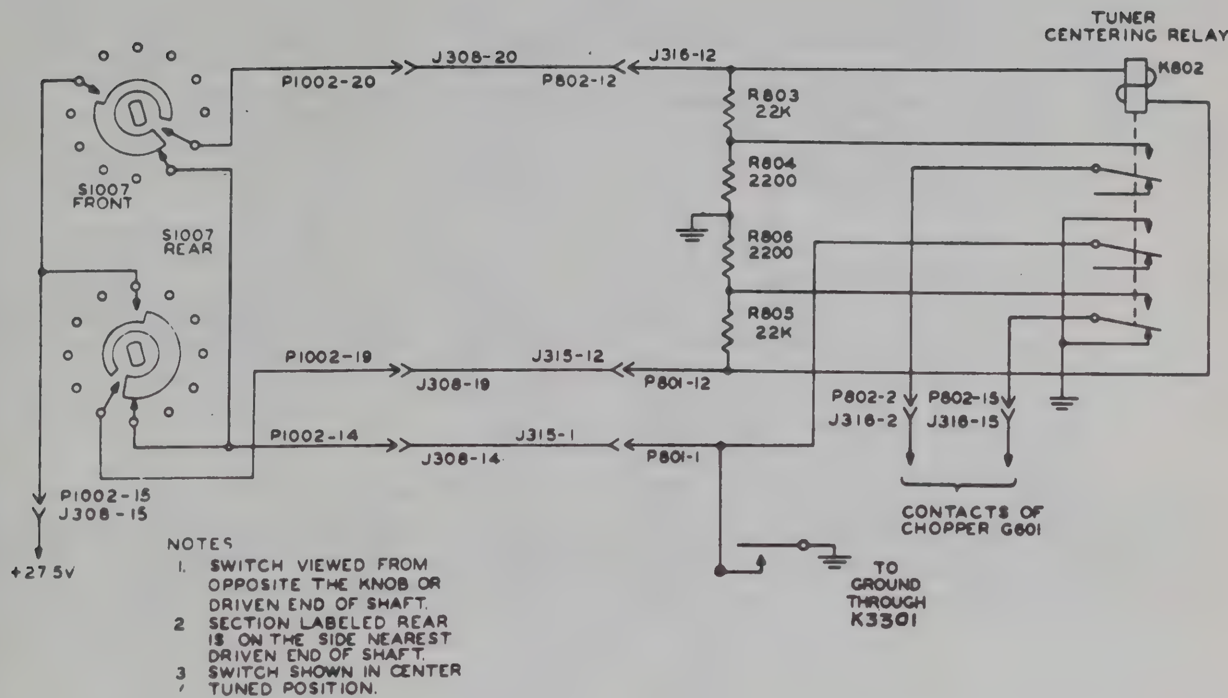


Figure 7-68. Tuner Table Centering Circuit, Simplified Schematic Diagram

7-146. Tuner Table Centering Circuit. The 1.75- to 3.5-megacycle signal from the cmo is applied to the control grid of tuner discriminator V1001. The tuner discriminator, in conjunction with the tuner servo amplifier subassembly (paragraph 7-157) and servomotor B102, performs the function of setting the tuner slugs to the correct operating position. With certain tuner slug positions, it might be possible to resonate the tuner circuits to the second harmonic of the master oscillator frequency. To prevent this from happening, the tuner table centering circuit, illustrated in figure 7-68, is used to assure the return of the tuner slugs to the center position before setting up. Switch wafers S1007 front and rear are illustrated in figure 7-68 in an open circuit condition. This is the position corresponding to the center position of the tuner slugs. When at rest at a certain frequency, switch wafers S1007 front and rear will be in a different position than illustrated; however, an open circuit for the 27.5-volt line will still exist until relay K3301 is energized whenever a new frequency is selected as described in paragraph 7-74. Assume that the tuner slug rack is at rest in such a position that S1007 front and rear are rotated one position clockwise and a new channel has been selected. A ground circuit now exists through contacts of K3301 through contacts of S1007 rear, through the field of relay K802, and through contacts of S1007 front to the 27.5-volt d-c line. Relay K802 is energized and provides its own holding ground. Contacts of relay K802 connect to contacts of chopper G601 within the tuner servo amplifier subassembly. With S1007 front and rear rotated one position clockwise, one of the G601 contacts is connected between the voltage divider arrangement of R804 and R803, resulting in a d-c voltage of approximately 2.6 volts being applied between the G601 contact and ground. The other G601 contact is connected across the parallel arrangement of R806 and R805 to ground, and no voltage is present at this contact. Conditions now are correct for the tuner servomechanism to operate, and servomotor B102 rotates the tuner slug rack and switch S1007 front and rear. Operation of the tuner servomechanism and circuitry is described in detail in paragraph 7-178. Switch S1007 front and rear will rotate until the wafers again are at an open circuit position, at which time the tuner slugs will be centered and relay K802 is deenergized. If, before the channel is changed, the tuner slug rack is at rest in such a position that the opposite direction of rotation of servomotor B102 is required to center the slugs, switch S1007 front and rear will be rotated in the opposite direction. This may be illustrated by assuming S1007 front and rear are rotated one position counterclock-

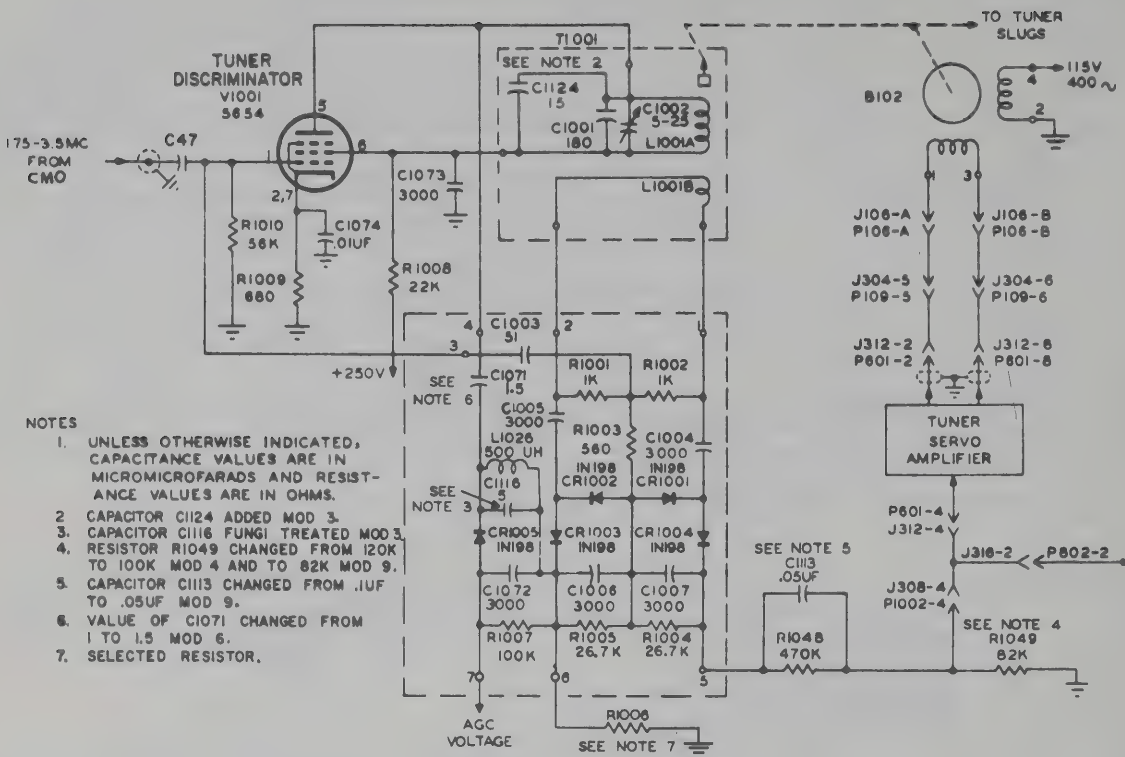


Figure 7–69. Tuner Discriminator Servomotor B102, Simplified Schematic Diagram

wise in figure 7–68. In this case, as soon as relay K3301 is energized, a ground circuit exists through contacts of K3301 through contacts of S1007 front, through the field of K802, and through contacts of S1007 rear to the 27.5-volt line. Relay K802 is energized again; however, the voltage divider resistors are now R805 and R806. As a result, the 2.6 volt dc is applied to the opposite G601 contact, and the rotation of servomotor B102 will be in the opposite direction. In this manner, the tuner slug rack is centered, and the possibility of frequency doubling is removed.

7–147. Tuner Discriminator. Refer to figure 7–69. After the tuner centering circuits have completed their cycle of operation, the tuner discriminator is free to drive the tuner slugs to the selected frequency. Relay K802 replaces the ground reference to chopper G601, allowing G601 to be controlled by the tuner discriminator d-c output. During the centering cycle, the tuner discriminator output is overridden by the 2.6-volt centering voltage and cannot drive the tuner servo amplifier circuits until the centering cycle is complete. The selected 1.75- to 3.5-megacycle output signal from the cmo is applied to the control grid of V1001 and to the common point of resistors R1001 and R1002. The 1.75- to 3.5-megacyle signal is amplified and developed across the tuned circuit consisting of the primary of T1001 and capacitors C1002, C1001, and C1124. The tuner discriminator tuned circuit resonates within the frequency range of 1.75 to 3.5 megacycles, and therefore follows the controlled master oscillator frequency. The slug of L1001A is ganged with servomotor B102, and will change positions during the channeling cycle, thereby tracking the selected cmo frequency. The secondary of T1001 (L1001B) is connected to resistors R1002 and R1001. The phase relationship of the signals present at both sides of resistors R1002 and R1001 depends upon the phase of the signal across V1001 plate tuned circuit with respect to the phase of the signal at V1001 control grid. A Foster-Seeley type discriminator circuit, consisting of rectifier diodes CR1001 through CR1004 and the associated resistors and capacitors, is used to produce a d-c output voltage. This d-c output voltage is amplified within the tuner servo amplifier subassembly, and used to drive servomotor B102, as will be described in paragraph 7–157.

7–148. At conditions of resonance (V1001 plate tuned circuit resonated with the grid signal), the phase relationship of the signal present at each side of L1001B will be 90 degrees removed from the signal at the junction point of R1001. (The voltage across R1001 is equal to the voltage across R1002 and is of the opposite phase.) The output of the tuner discriminator circuit, through the parallel arrangement

of C1113 and R1048, therefore is zero. If the slug of L1001 is not adjusted to the correct position for resonance with the grid signal, the balance condition will no longer exist. Assume the slug of L1001A is off resonance in a direction causing the voltage across R1001 to be larger than the voltage across R1002 because of the vector addition of the grid and plate signals. In this case, the charge path for C1005 is through CR1002, R1003, and R1001. On the following alternation of L1001B, C1005 will discharge through R1001, R1003, R1005, and CR1003. A voltage doubling action occurs, with the net C1005 current adding to the net L1001B current. The discriminator output voltage is no longer zero, but is a particular amplitude dc, polarity dependent upon the direction off resonance and amplitude dependent upon the amount of resonance. If the slug of L1001A is off resonance causing the voltage across R1002 to be larger than the voltage across R1001, capacitor C1004 becomes the dominant capacitor. In this case, C1004 charges through CR1001, R1003, and R1002. The discharge path is through R1002, R1003, R1004, and CR1004, the current adding to the net L1001B current. The output d-c voltage is of the opposite polarity, amplitude dependent upon the distance off resonance. At resonance, there will be no net current, either from capacitors C1004 and C1005 or from L1001B. Therefore, as soon as the slug of L1001A is correctly set up, the tuner discriminator output will be zero, and servomotor B102 no longer will operate. The d-c output is applied through the parallel combination of R1048 and C1113 and developed across R1049. The time constant formed by R1048 and C1113 will prevent overcorrection or hunting while not destroying the sensitivity of the frequency correction circuits.

7–149. A part of the signal from the plate of V1001 is coupled through capacitor C1071 and developed across a tuned circuit consisting of L1026 and C1116. This tuned circuit, in conjunction with the distributed capacity, is resonant at the lower and midrange of the cmo frequency spectrum, and tends to increase the voltage across CR1005 for these frequencies. The signal is rectified by CR1005 and filtered by the parallel combination of capacitor C1007 and resistors R1006 and R1107. The resultant voltage is a negative d-c, amplitude dependent upon the input signal to V1001. This negative d-c voltage is used to provide agc to variable i-f amplifier V1002, and compensates for a varying cmo output.

7–150. TUNER SERVO AMPLIFIER SUBASSEMBLY.

7–151. GENERAL DATA. The tuner servo amplifier subassembly is a self-contained unit which is a part of the complete servo tuning system. Therefore, when troubleshooting the tuner servo amplifier subassembly, the complete servo system must be considered. Reference must be made to paragraphs 4–24 and 7–146 in order to understand the function of this subassembly. As no lubrication is required in this subassembly, the lubrication paragraph has been omitted.

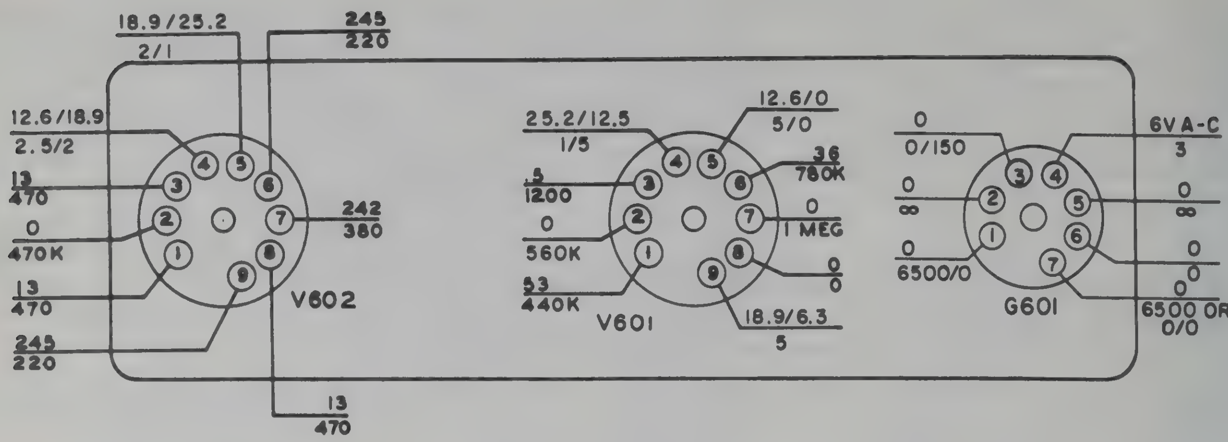
7–152. MINIMUM PERFORMANCE STANDARDS. Operation of the tuner servo amplifier can be checked by selecting a new frequency at the radio set control and observing the action of the slug rack on the tuner subassembly and the servo motor B102 located in the front panel subassembly. If the slug rack operates normally and the servo motor comes to a complete rest after selecting the new frequency, the unit is performing normally. The output of the subassembly can be checked as follows:

a. Connect VTVM TS–375/U to pin 8 of J312/P601 and pin 2 of J312/P601 (test point K).

b. Select a new frequency at the radio set control.

c. Note the voltage readings on the vtvm. After the tuning cycle has been completed, the vtvm reading will be zero.

7–153. CHECK-OUT OR ANALYSIS. When faults are encountered in the tuning of the tuner subassembly the complete servo system must be considered. If, for example, the slug rack of the tuner subassembly remains at rest when a new channel has been selected, the tuner servo amplifier may have no output or the input from the discriminator (see paragraph 7–90) may be missing. In general, follow a logical sequence in determining where the trouble is located. When trouble is traced to the tuner servo amplifier subassembly, the most logical fault would be a defective tube or chopper. Remove the tube shield and feel the chopper during the channeling cycle. If no vibration is apparent, replace the chopper. If a replaced chopper does not operate, check the 6.3-volt, 400 cps source. Other troubles in the unit are of a more subtle nature, generally resulting from improper feedback conditions. Improper B-plus decoupling, for example, could cause this condition. Check capacitors C603 and C604 and replace if defective. An unbalanced bridge circuit also may result in feedback through transformer T601 and produce a drive voltage to servomotor B102 at a time when the servomechanism should be at rest. Where this occurs the motor will oscillate. This condition can be corrected by rebalancing the bridge circuit as described in paragraph 7–156. Figure 7–71 is the schematic diagram of the unit and figure 7–70 shows the normal voltage and resistance measurements at the tube socket pins. Where the output is missing or abnormally low, and the chopper and tubes are of good quality, voltage and resistance measurements at the tube socket pins should be made and comparade with those of figure 7–70 in an effort to locate a defective detail part. If the feedback transformer is suspected, it can be checked by measuring its d-c resistance. A normally operating unit will have a resistance of 550 ohms between terminals 1 and 2 (test points F1 and F2) and 6500 ohms between terminals 3 and 4 (test points F3 and F4). As a defect should be located quickly in this subassembly no trouble analysis chart has been provided.



NOTES:
1. VOLTAGE MEASUREMENTS TAKEN DURING CW TRANSMISSION.
2. RESISTANCE MEASUREMENTS TAKEN WITH 618S-1/MC REMOVED FROM 350S-1 OR 350S-3 AND P301-14 GROUNDED TO CHASSIS.
3. ALL MEASUREMENTS WITH RESPECT TO CHASSIS GROUND.
4. WHERE TWO VOLTAGES APPEAR, THE FIRST REFERS TO THE TUNER SERVO AMPLIFIER SUBASSEMBLY AND THE SECOND REFERS TO THE PA SERVO AMPLIFIER SUBASSEMBLY.
5. ALL VOLTAGES ARE D-C UNLESS OTHERWISE INDICATED.

Figure 7–70. Tuner Servo Amplifier Subassembly Tube Voltage and Resistance Diagram

7–154. REMOVAL AND REPLACEMENT. The tuner servo amplifier subassembly can be removed as follows:

a. Loosen the two redheaded captive screws.

b. Pull the unit straight up and out of the chassis receptacle.

7–155. Access to the tube socket pins and detail parts can be attained by removing the two screws securing the shield cover in place and sliding the latter up and away from the unit. Reassembly and replacement can be accomplished by reversing the foregoing procedures.

7–156. ALINEMENT AND ADJUSTMENT. Rebalancing of the bridge circuit can be accomplished as follows:

a. Remove the subassembly from the main chassis as described in paragraph 7–154 and disassemble as described in paragraph 7–155.

b. Connect VTVM TS–375/U to terminals 3 and 4 (test points F1 and F2) of T601.

c. Remove R612 from the circuit and connect a resistance decade box containing values of 150 to 470 ohms between the points from which R612 was removed.

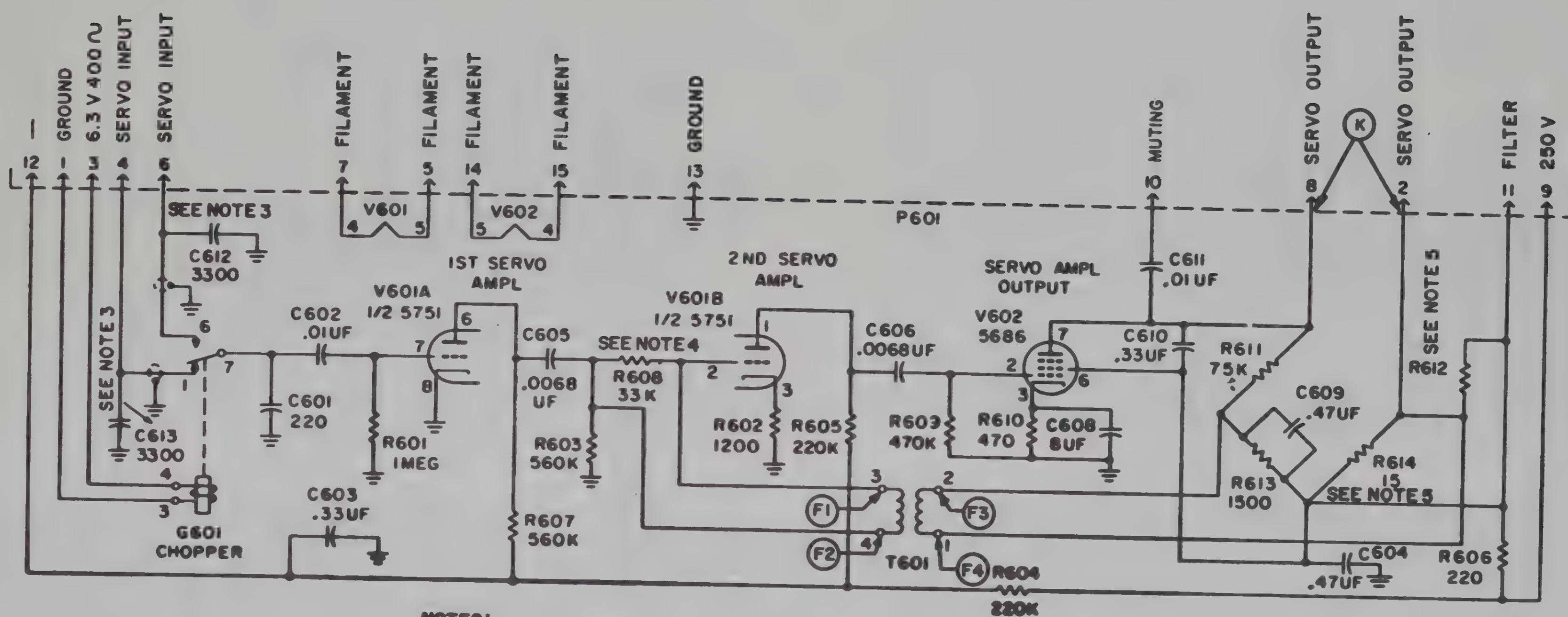
d. Replace the subassembly on the main chassis.

e. Select a new frequency and stall the servomotor B102 by blocking the gear coupler with a screw driver.

f. Adjust the decade box switches for a minimum voltage reading on the vtvm. Note the resistance reading on the decade box and solder the value closest to the indicated value in place of R612. Resistances having values of 150, 180, 220, 270, 330, 390, and 470 ohms should be available in order to replace R612.

7–157. DETAILED CIRCUIT ANALYSIS. As the operation of the tuner servo amplifier subassembly is only a part of the tuner subassembly servo tuning system, the explanation that follows is essentially a continuation of the circuit described in paragraph 7–146. It is recommended that paragraphs 7–146 and 7–147 be studied before proceeding.

7–158. Refer to figure 7–72. The d-c output from the tuner discriminator circuit is applied to the lower contact of chopper G601. The top contact of G601 is grounded after relay K802 has been deenergized. Relay K802 is deenergized following the tuner table centering circuit cycle of operation, as was described in paragraph 7–146. Capacitors C601, C612, and C613 bypass stray signals from the input circuit of V601A. The d-c input voltage to G601 is converted into a square wave output, phase dependent upon the direction of frequency error in the tuner slug rack, and amplitude dependent upon the amplitude of the fre-

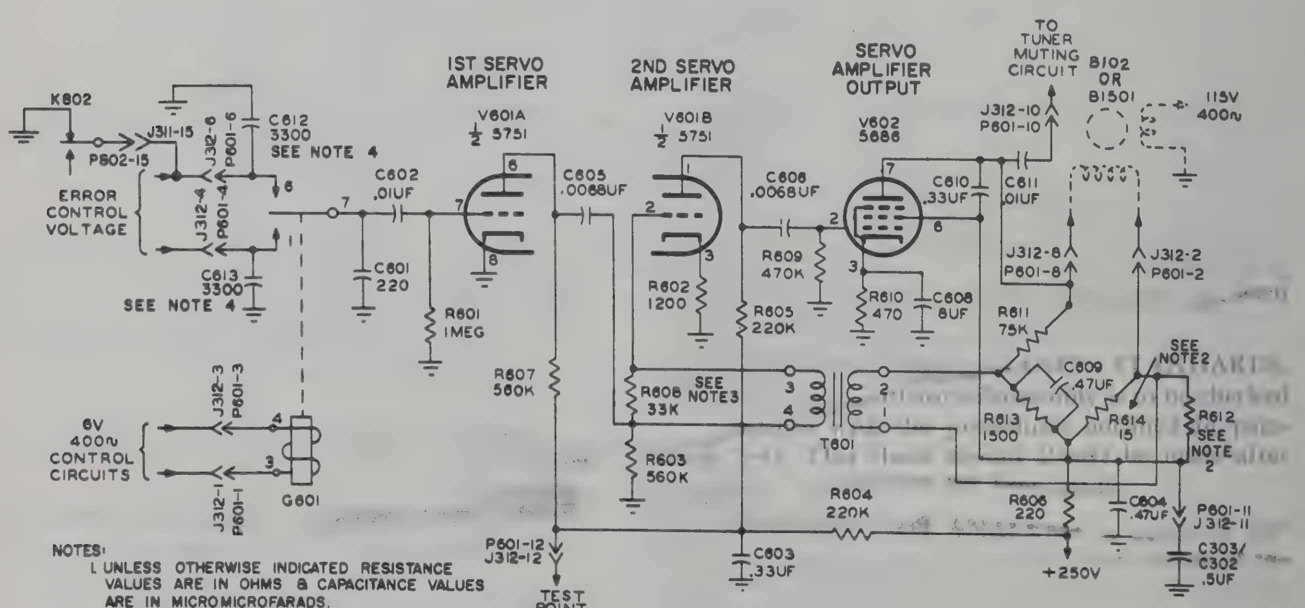


NOTES:

1. ALL RESISTANCE VALUES ARE IN OHMS UNLESS OTHERWISE INDICATED.
2. ALL CAPACITORS ARE IN UUF UNLESS OTHERWISE INDICATED.
3. CAPACITORS C612 & C613 CHANGED FROM 3000 TO 3300; MOD 3 OF TUNER SERVO AMPLIFIER.
4. VALUE OF R608 CHANGED FROM 68K TO 33K; MOD 2 OF TUNER SERVO AMPLIFIER.
5. VALUE OF R614 CHANGED FROM 10 TO 15 AND R612 ADDED. VALUE OF R612 IS SELECTED, REFER TO T.O. 12R2-4-6-4; MOD 1 OF TUNER SERVO AMPLIFIER.

Figure 7–71. Tuner Servo Amplifier Subassembly, Schematic Diagram

quency error. (The frequency error of the tuner slug rack is determined by the slug positions.) The reference voltage for chopper G601 is 6.3 volts, 400 cps from Power Supply 416W–1. The square wave output signal from chopper G601 either leads or lags the 6.3-volt reference signal. The chopper output signal is removed from the 6.3-volt reference signal by approximately 70°. The 6.3-volt reference signal is shifted in phase in Power Supply 416W–1 by approximately 20° with respect to the 115-volt a-c source. The chopper output signal, therefore, leads or lags the 115-volt reference by approximately 90°. This phase relationship is necessary to drive servomotor B102 during the tuner centering or setup cycle. The 400-cps signal from G601 is coupled through capacitor C602 and developed across grid resistor R601. Capacitor C602 isolates the grid of V601A from the ground reference of chopper G601, thereby allowing the grid of V601A to swing both directions from the average value of the square wave signal. This doubles the signal amplitude which may be applied to V601A. The 400-cps signal is amplified by V601A and coupled through capacitor C605 to the second servo amplifier, V601B. An inverse feedback voltage from the output of V602 also is coupled to the grid circuit of V601B. This feedback voltage is proportional to the speed of servomotor B102, and prevents overcorrection or hunting. The 400-cps signal is amplified by V601B and coupled to the final servo amplifier stage, V602. A portion of the output signal is coupled through capacitor C611 to the tuner muting circuit described in paragraph 7–146. The rest of the 400-cps signal is developed across the bridge circuit of servomotor B102. Capacitor C610 resonates one winding of B102 to the 400-cps frequency. The bridge circuit consists of one winding of servomotor B102, resistors R611, R613, R614, R612, and capacitor C609. The function of the bridge circuit is to establish a feedback voltage to the primary of transformer T601 which is proportional to the motor speed. The bridge circuit will be described in detail in the following paragraph. The 400-cps output signal is applied to one winding of B102. Servomotor B102 is a two-phase, 400-cps motor, which is used to drive the slugs within the tuner subassembly. In order for B102 to operate, the two signals must be apart by 90 degrees. One winding of B102 connects to the 115-volt, 400-cps reference line. The other winding connects to the servo amplifier output signal. The phase of the servo amplifier output signal with respect to the phase of the 115-volt reference voltage will be either leading or lagging 90 degrees. When the d-c input to chopper G601 is negative, B102 will rotate



NOTES:
1. UNLESS OTHERWISE INDICATED RESISTANCE VALUES ARE IN OHMS & CAPACITANCE VALUES ARE IN MICROMICROFARADS.
2. VALUE OF R614 CHANGED FROM 10 TO 15 AND R612 ADDED MOD 1. RESISTOR R612 IS SELECTED VALUE.
3. VALUE OF R608 CHANGED FROM 68K TO 33K MOD 2.
4. VALUE OF C612 AND C613 CHANGED FROM 3000 TO 3300 MOD 3.

Figure 7–72. Tuner and PA Servo Amplifier Systems, Simplified Schematic Diagram

in one direction; when positive, B102 will rotate in the opposite direction. The polarity of the d-c input voltage is dependent upon the direction of frequency error, and therefore, B102 will drive the tuner slugs either up or down, depending upon the direction necessary to set up the tuned circuits. After the slugs have been driven to the setup position, the d-c voltage to chopper G601 is removed, and B102 stops. The servo amplifier circuits employed for the power amplifier subassembly are identical to those described in this paragraph. The origin of the d-c input voltage from the power amplifier subassembly is described in detail in paragraphs 7-172 and 7-173. Otherwise, the operation is identical, and the output of V602 will drive servomotor B1501 to set up the power amplifier frequency. The mechanical operation of servomotors B102 and B1501 are described in detail (figure 7-86) in paragraphs 7-176 through 7-179.

7-159. Reference is made to figure 7-73 for a functional diagram of the rate bridge circuits employed in the tuner servo amplifier subassembly. In this diagram, g represents the counter emf of servomotor B102; R3 and L3 represent the plate winding of B102; R4 represents the parallel combination of R614 and R612; R2 and C2 represent the parallel combination of R613 and C609, respectively; the power source represents the 400-cps output signal from V602; and V represents the signal applied to the primary of transformer T601. The circuit illustrated in figure 7-73 is electrically equivalent to the circuitry at the plate of V602. When the bridge circuit is balanced, zero voltage from the power source will be present between terminals V. It can be proved mathematically that two independent conditions for balance exist. These are: R1 R4 = R2 R3 and R1 R4 C2 = L3. Notice that the two equations have no frequency terms. Theoretically, the bridge is ideally balanced at all frequencies. With the bridge balanced, no voltage will be

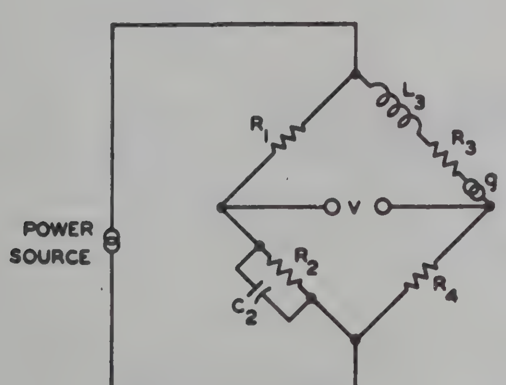


Figure 7-73. Rate Bridge Functional Diagram

present from the power source; however, since g is in one leg only, a voltage proportional to the speed of motor B102 will be present between terminals V. The voltage between terminals V is applied to the primary of T601, and is used to limit the gain of V601B and V602.

7-160. POWER AMPLIFIER SUBASSEMBLY.

7-161. GENERAL DATA. The power amplifier subassembly contains three tubes, the required tuning and antenna switching and matching circuits, a discriminator, and a sidetone rectifier circuit which is used to control the gating circuit in the bfo and sidetone gate subassembly (see paragraph 7-239). Tuning is accomplished by shunting inductors with switch selected capacitors and varying the inductance in the plate circuit of the power amplifier stage for the various frequency ranges. The desired shunt capacitor selector switches are controlled by B102 (located in the front panel subassembly), and the inductance variation and control is accomplished by means of the discriminator circuit, a self-contained servomotor (B1501), and the pa servo amplifier subassembly. The latter subassembly is identical to the tuner servo amplifier subassembly described in paragraph 7-150, therefore both units can be interchanged. This interchangeability may be helpful when troubleshooting the equipment.

7-162. MINIMUM PERFORMANCE STANDARDS. The power amplifier subassembly must be checked as a part of the overall equipment in the bench test setup shown in figure 2-2. Proceed as follows to test the unit.

a. Connect the dummy load and the r-f probe of the vtvm to the antenna output receptacle (test point 1).

b. Connect a telegraph key to test point 6 or a microphone to test point 5. All other test equipment should be removed for this test.

c. Operate the function switch on Radio Set Control CPC-1 to the "AME" position and allow at least 10 minutes for warmup. After warmup, rotate the function switch to the "CW" position.

d. Set the 'CHANNEL" select switches on the radio set control to "BKBB" (2.0 mc) and allow the system to complete the tuning cycle.

e. Depress the telegraph key or microphone push-to-talk button and observe the indication on the vtvm. The reading should not be less than 70 volts rms.

f. Repeat step e for each frequency listed in figure 7-74.

Band	Dial Settings	Frequency (MC)	Volts RMS (Min.)
1	BKBB	2.0	70
1	GCMM	3.7495	70
2	HKBB	3.75	70
2	MCZM	7.2495	70
3	NKBB	7.25	70
3	TCZZ	14.2495	68
4	VKBB	14.25	68
4	YFYK	25.00	68

Figure 7–74. R-F Power Output Test Frequencies

7–163. CHECK-OUT OR ANALYSIS. Before performing any of the trouble isolation procedures outlined in figure 7–75, make a thorough visual inspection for mechanical faults such as loose or unmeshed gears, broken leads or connectors, solder shorts, and overheated detail parts. Test tubes in Tube Tester TV–3B/U. If trouble is due to improper tuning, make certain the defect is in the power amplifier subassembly and not in the autopositioner drive motor (B102 located in the front panel subassembly) or the power amplifier servo amplifier subassembly. Figure 7–81 is the schematic diagram and figure 7–77 shows the subassembly. The voltage and resistance measurements shown in figure 7–76 should be made to help isolate the trouble to a detail part of group of detail parts.

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
1	Visual	None	Function switch on Radio Set Control CPC–1 set to any on position with "CHANNEL" select switches set for any frequency.	All tubes illuminated normally.	1a. Defective tube filament. 1b. Resistor R306 open. 1c. Defect in P1501/J305 or chassis wiring.
2	Visual	Front panel mounted meter.	Set meter switch to "P.A. PL" position. Key or modulate the transmitter while observing the meter.	Indicator hand in red area of scale.	2a. Short circuit or high resistance in plate or screen-grid voltage circuits. Check P1501, P1502, R1522, C1502, C1503, C1504, C1522, C1524, E1501, E1502, E1503 and L1503. 2b. Check operation and contact closure of K1501. 2c. Clean and burnish contacts on L1502. 2d. Clean coaxial cable to J110 for open or short circuit.
3	Visual	Same as step 2.	Set meter switch to "P.A. GRID" position.	Indicator hand near red area of scale.	3a. Where bias voltage is low or missing, check bias circuit. Should be minimum of 65 volts rms. 3b. Where reverse grid current is indicated, check for grid-to-cathode short in V1501, V1502, V1503.
4	Visual	None.	Function switch on Radio Set Control CPC–1 set to any on position. Change "CHANNEL" select switch settings to obtain new frequency and observe tuning operation.	Roller on L1502 centers, then resets to new frequency.	4a. Replace pa servo amplifier and recheck. If this clears fault, defect is in pa servo amplifier. Check as outlined in paragraph 7–174. 4b. Check operation of K1501 and K1502. 4c. No d-c voltage from pa discriminator circuit. 4d. Lack of 400 cps voltage at terminal 4 of B1501.

Figure 7–75. Power Amplifier Subassembly Trouble Analysis Chart (Sheet 1 of 2)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
4 (cont)					4e. Defective mechanical drive. 4f. Servomotor B1502 defective.
5	1	Bird Model 82 Dummy load, Frequency Meter AN/USM–26, and 1 megohm resistor.	Check frequency output of equipment for each of the frequencies listed in figure 7–74. Observe positioning of roller on L1502 for each band and compare with figure 7–83.	Equipment tunes to all frequencies listed in figure 7–74. Roller on L1502 should be positioned within the limits indicated in figure 7–83.	5a. Defective bandswitch S1501 through S1504 and S1506. 5b. Check alinement of bandswitches as outlined in paragraph 7–165 and shown in figures 7–78 and 7–79. 5c. Check for loose mechanical coupling between bandswitch drive and bandswitches. Tighten loose coupler in correct position or repair as required. 5d. Defective servomotor B1501.
6	1	Bird Model 82 Dummy Load, Oscilloscope TEK 545, and 25 uuf capacitor.	Check for parasitic oscillations on all frequencies listed in figure 7–74.	Sine wave output at rated power as observed on oscilloscope. No trace of parasitics.	6a. Check parasitic suppressors E1501 through E1506, for defects. 6b. Check C1502, C1503, and C1504 for an open or leaky condition. 6c. Check neutralizing capacitors S1517, C1532, and C1513 for opens.

Figure 7–75. Power Amplifier Subassembly Trouble Analysis Chart (Sheet 2 of 2)

WARNING

When performing voltage checks in the power amplifier subassembly special care must be taken to avoid contact with all circuits carrying plate voltages. Voltages present in this subassembly are dangerous and could be fatal if physical contact is made.

7–164. REMOVAL AND REPLACEMENT. Perform the following operations when removing the power amplifier subassembly from the main chassis.

a. Tune the receiver-transmitter to any frequency in band 4. Note that when tuned to any frequency in band 4, that the green dot on the Oldham coupler is straight up.

b. Loosen the four redheaded captive screws until they turn freely.

c. Disconnect plug P1503 from jack J1001.

d. Lift the subassembly straight up and out of the main chassis receptacles.

e. When reinstalling the power amplifier subassembly, the green dots on the Oldham couplers on both the power amplifier and tuner subassemblies should be in the up position.

f. Insert the power amplifier subassembly carefully, into the main chassis receptacles while observing that the couplers mesh properly.

g. Tighten the four redheaded captive screws, tightening each in small increments until the subassembly is properly seated.

h. Insert plug P1503 into jack J1001.

7–165. ALINEMENT AND ADJUSTMENT. Paragraphs 7–166 through 7–168 describe the procedures for alinement of the power amplifier subassembly. During the mechanical alinement procedures, the power amplifier subassembly should be removed from the main chassis. Refer to paragraph 7–164 for removal and replacement procedures. During the electrical alinement procedures, paragraph 7–168, the power amplifier subassembly should be installed in the main chassis, and should be connected in a test bench setup similar to figure 2–2. Further electrical adjustments

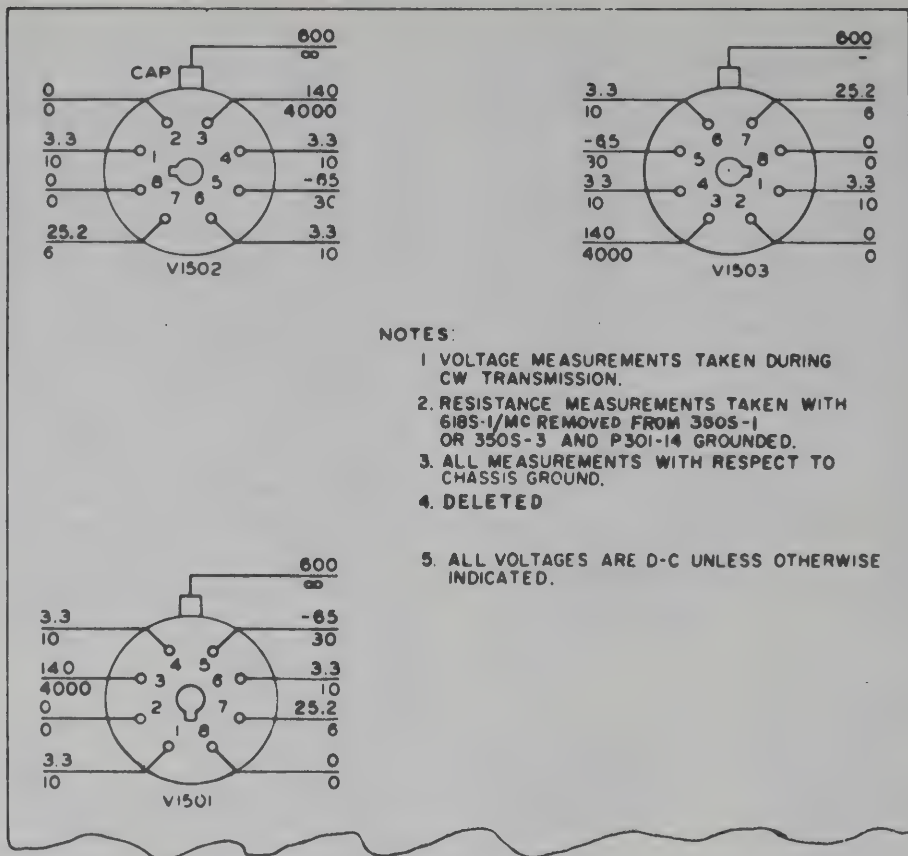


Figure 7–76. Power Amplifier Subassembly Tube Voltage and Resistance Diagram

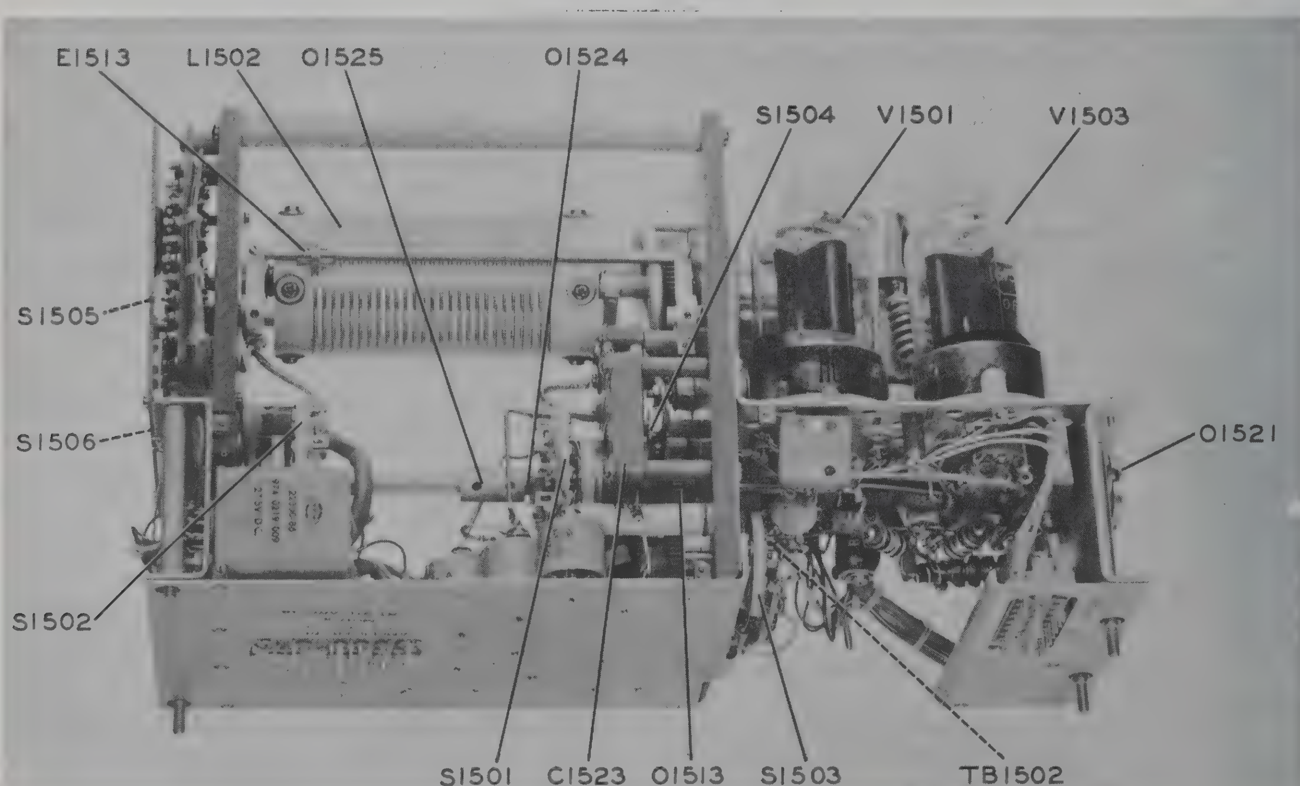


Figure 7–77. Power Amplifier Subassembly, Left Oblique View, Mechanical Alinement Points

than those detailed in paragraph 7-168 are not recommended for field maintenance personnel. All electrical and mechanical alinement points are identified in figures 7-77 through 7-79. All test points are identified in figures 2-2, 7-2, and 7-3.

7-166. Switch Alinement and Adjustments. Before performing the procedures outlined in steps a through d, the power amplifier subassembly should be removed from the main chassis. Perform the following operations with reference to figures 7-77 through 7-79.

a. The contact pressure on S1504 should be 80-120 grams. Adjust the setscrews on both switch arms for this pressure, using a gram gauge or similar instrument for measurement. The long switch arm or S1504 should clear the cam gear by 1/64 inch when this switch is in the closed position.

b. Synchronize S1503 and S1504, as shown in figure 7-78, so that S1504 is open when S1503 is in the band 1 position and closed in band positions 2, 3, and 4. It may be necessary to loosen setscrew in gear O1513. Refer to figures 7-77 and 7-79 for location of this gear.

Note

It may be necessary to move capacitor C1523 in order to place a Bristo wrench in the setscrews. This can be accomplished by removing the screws, nuts, and spacers used to mount C1523, and the screw and nut holding the ground lead of C1523 in place. Capacitor C1523 then can be pushed aside during alinement.

c. Set S1503 in the band 4 position. Refer to figure 7-78. Position coupler O1521 and switches S1501, S1502, S1503, and S1506 as indicated in figure 7-78. To accomplish this, it may be necessary to loosen setscrews in the clamp of coupler O1521 and rotate the switch shaft manually. Switch S1505 will be alined according to the following paragraph.

d. Tighten all setscrews permanently after completing steps b and c.

7-167. Roller Coil Adjustments. Steps a through c describe the mechanical adjustments necessary for synchronization of main tuning inductor L1502. Before performing the procedures outlined in steps a through c, the power amplifier subassembly should be removed from the main chassis. Perform the following operations with reference to figure 7-77.

a. The contact pressure on the front and back slip rings of L1502 should be 80-120 grams. Adjust the setscrews of each contact for this pressure, using a gram gauge or similar instrument for measurement. The pressure, at the point of contact between the roller inductor (L1502) and the roller wheel (E1513), should be 12 to 14 ounces. Adjust for this presure with the roller wheel at each end of L1502.

b. Rotate inductor L1502 until switch S1505 is in the position shown in figure 7-78.

c. Roller E1513 should make contact with L1502 approximately one turn from the end of L1502 (end toward S1505). Moving the roller along the shaft, adjust the position of roller E1513 by applying pressure to the roller shaft in a direction away from L1502.

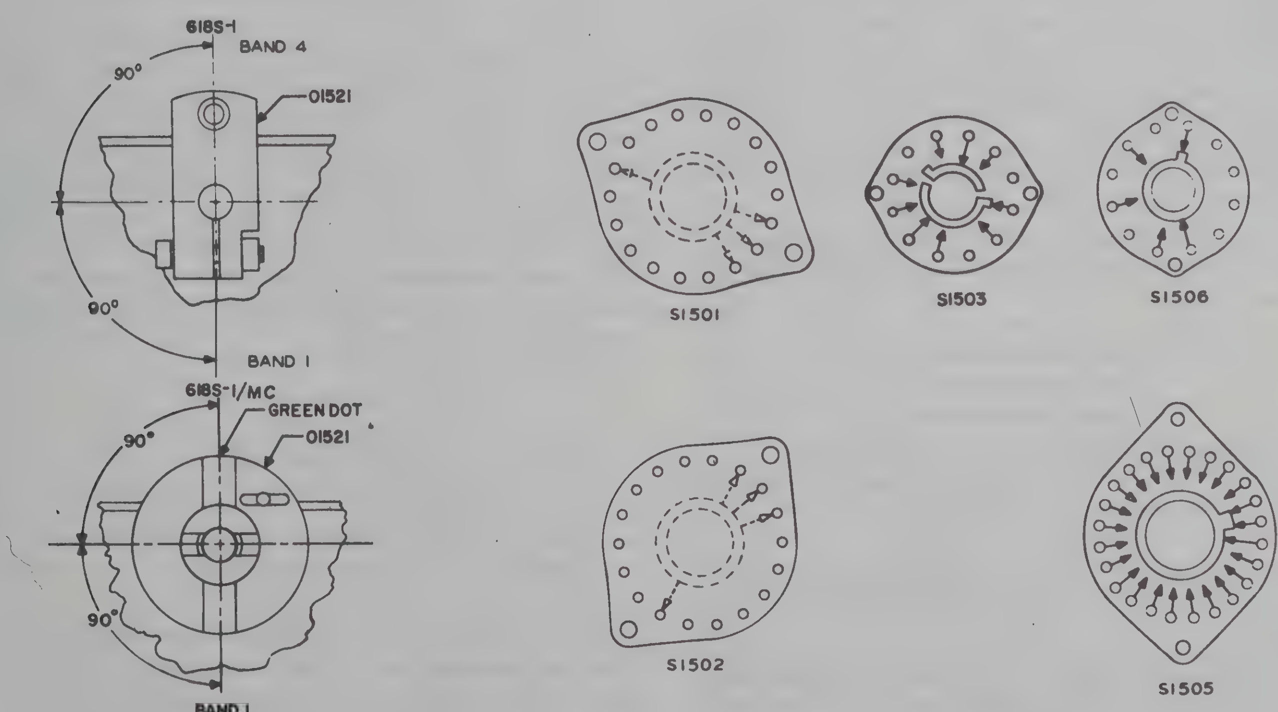


Figure 7-78. Power Amplifier Subassembly, Switch and Coupler Alinement

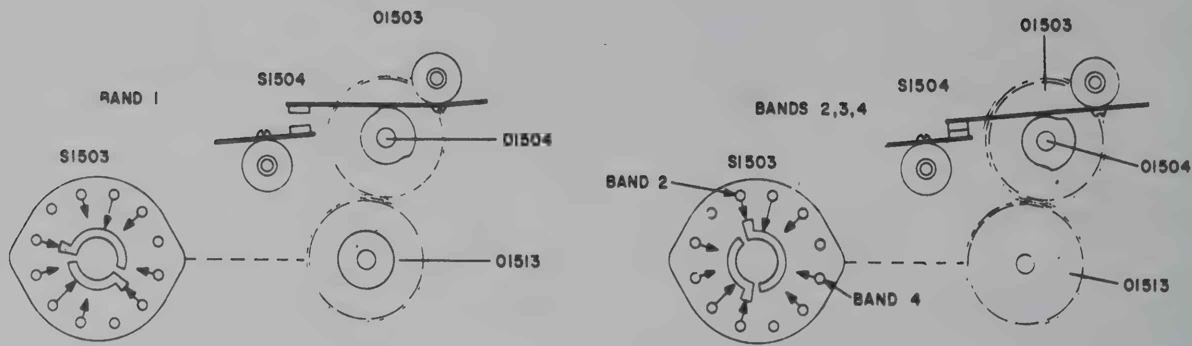


Figure 7–79. Power Amplifier Subassembly, Alinement of Switch S1504

7–168. Discriminator Adjustments. In the following steps, the power amplifier subassembly should be replaced in the main chassis, which should be connected in a test bench setup. Perform the following operations:

a. Operate the function switch to the "AME" position and allow at least ten minutes for warmup.

b. Depress the telegraph key or microphone push-to-talk button.

c. Remove the pa chopper (G601 of the pa servo amplifier subassembly).

d. Observe the front panel meter with the meter selector switch in the "P.A. PL". position.

e. Rotate the roller inductor (L1502) with an insulated material, and observe if the meter indication can be reduced.

CAUTION

An insulated material must be used to rotate L1502. Do not use a material which will draw r-f or short out L1502.

f. If the current can be reduced by more than 1/5 scale division in step e, resistor R1524 should be replaced.

g. Procure values of R1524 as follows: 1200, 1500, 1800, 2200, 2700, 3300, 3900, 5600, and 8200 ohms. Each resistor is 1/2 watt, ±10%.

h. Remove resistor R1524 from terminal board TB1502, and replace with various values obtained in step g. Select a value which gives a scale reduction of less than 1/5 division on the front panel meter when L1502 is rotated throughout its range.

i. Replace the old R1524 with the new resistor determined in step h.

7–169. LUBRICATION. The mechanism of this subassembly should be inspected at 1,000-hour intervals. If the parts appear to be clean, sufficiently lubricated, and free running, lubrication can be omitted until the next inspection period. If old lubricant has become hard or dirty, clean the parts to be lubricated with carbon tetrachloride (o-c-14(4)) or Stoddard solvent, and dry with compressed air. Refer to figures 7–80 for lubrication details.

CAUTION

The subassembly should never be operated after having been cleaned until relubrication procedures have been performed.

7–170. All metal-to-metal gears (reference number 9) of the subassembly are to be lubricated by applying MIL-G-23827A lubricant with a brush. All porous, ball (reference number 10), and servo motor bearings (11)

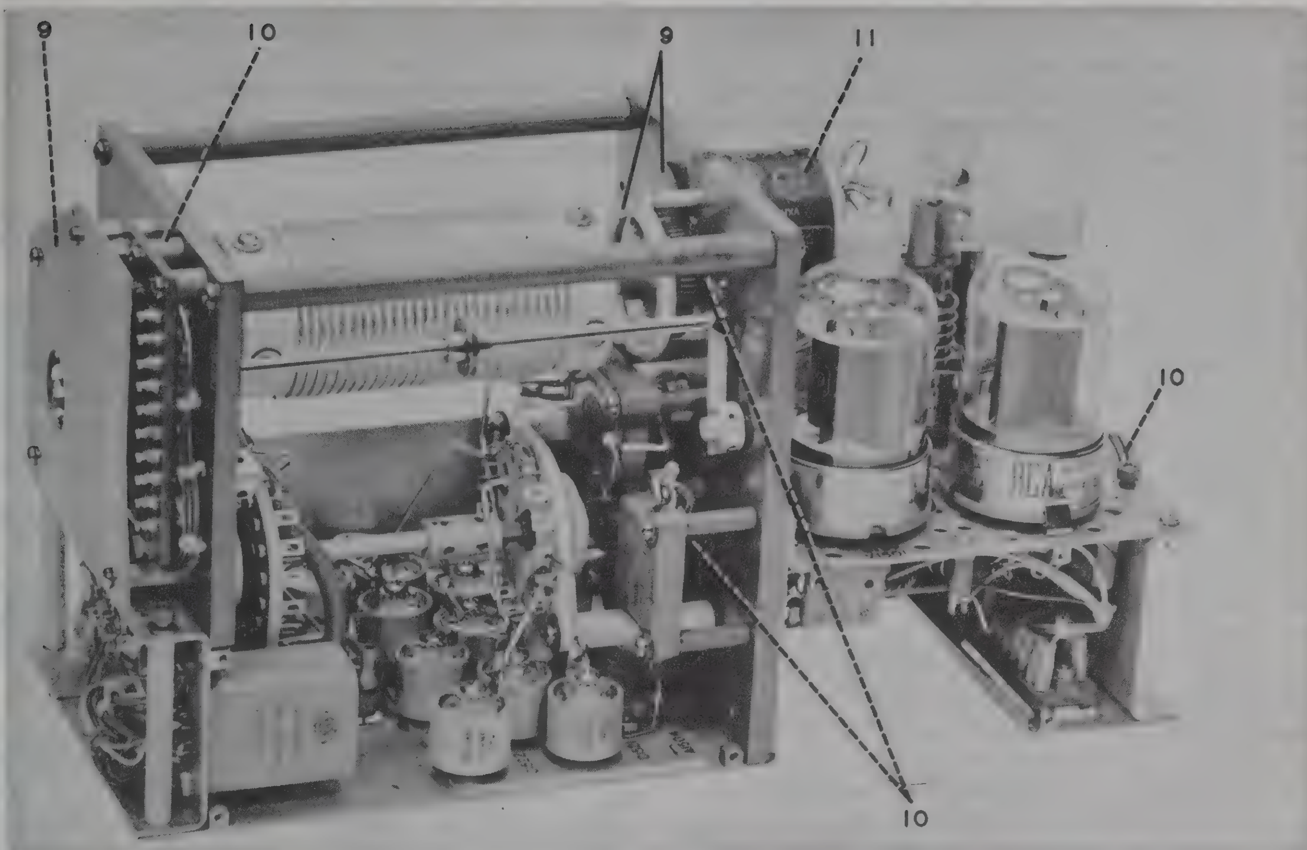


Figure 7-80. Power Amplifier Subassembly, Lubrication Points

are to be lubricated by applying MIL-L-7870 lubricant with a dropper. Figure 7-80 must be referenced in order to locate all points of lubrication.

7-171. DETAILED CIRCUIT ANALYSIS. As shown in figure 7-82, the r-f signal from the drivers is coupled through capacitor C1501 and parasitic suppressors E1504, E1505, and E1506 to the control grids of three type 6159 tubes connected in parallel. Provision is made for metering both the cathode and grid currents of the power amplifier tubes. Resistor R1502 is the current meter shunt for the cathode circuit. The power amplifier tubes operate in Class AB1. A negative 65-volt bias for the grids is connected through the contacts of K302 and the input resistor, R3527 for the automatic level control (alc) circuit (to be described in paragraph 7-198) when operating in the ame and ssb modes. When operating in the cw mode, the contacts on K302 operate to remove the alc circuit from the grids and to reduce the applied bias by inserting resistor R314 in series with the negative 65 volts. A B-plus voltage of 600 volts dc is supplied to the plates, and the screen grids are supplied 250 volts dc through a 4000-ohm dropping resistor R301. Resistor R1522 is grounded through contacts on the antenna transfer relay K1501 during the interval when the transmitter is not keyed, and through contacts of automatic keying relay K708 within the antenna tuner during the channeling cycle. This grounding action shunts the screen grids to ground through 7500 ohms, which reduces the screen grid voltages. As a result, the plate current of the power amplifier tubes is reduced during the channeling cycle and when the transmitter is not being keyed. The r-f signal is amplified by the parallel connected combination of V1501, V1502, and V1503 and developed across the plate loading inductor L1503. On band 1, switch S1504 will be in the position illustrated in figure 7-82, and in bands 2, 3, and 4, the position of S1504 will be changed to shunt capacitor C1523 from the tap of L1503 to ground. Thus a larger inductance is available to load the lower frequencies in band 1, and a small inductance loads the higher frequencies of bands 2, 3, and 4 as shown in figure 7-83. The signal is coupled through capacitor C1506 and developed across the pi section tuned circuit which consists of CA, L1502, CB, and LA. Inductor L1502 is the main tuning element and is tunable continuously through operation of its own servo system described in paragraph 7-156. The capacitor combinations contained in CA and CB are selected by the bandswitch motor, B103, as is the tap on inductor L1504 (LA). Reference is made to the table in figure 7-82 which lists the capacitors used with CA and CB as well as the portion of LA selected with each band. The listing under S1503, CC, has reference to the power amplifier servo system, which includes an external servo

amplifier subassembly, the discriminator circuitry included with diode rectifiers CR1501 and CR1502, power amplifier servo motor, B1501, the table containing circuits, and detail parts listed under CC. (The power amplifier servo system will be explained in detail in paragraph 7–171.) A portion of the r-f signal across CA, L1502, CB, and LA is coupled back to the paralleled grid circuits by the capacitor combination of C1513, C1532, and C1517. The voltage is made slightly variable by capacitor C1532 and serves to neutralize the power amplifier stage. Another portion of the signal voltage is applied through the paralleled resistor combination of R1508 and R1521 to the sidetone gate control rectifier circuit. This circuit consists of R1523, L1505, C1514, R1528, and diode CR1503. The d-c output of the circuit is used to energize the sidetone gate circuit to be described in paragraph 7–246. The r-f output signal is connected through a set of contacts on antenna transfer relay K1501 and through an r-f coaxial cable to the Automatic Antenna Tuner 180L–3, which in turn couples the r-f signal to the antenna.

7–172. Band Centering Circuits. Reference is made to the simplified schematic diagram, figure 7–82. Rough tuning of the power amplifier subassembly consists of selecting the proper network values of inductance and capacitance for the band selected. Switches S1501 through S1504 perform these functions. Switches S1501 through S1504 and S1506 are operated by the band selector autopositioner motor, B103. Switches S1506 and S1505 and the associated circuits perform the function of placing the roller of main tuning inductor L1502 to the center position of the band selected. Figure 7–83 illustrates the approximate tuning ranges for each band. The rear section of switch S1505 serves as a protective stop mechanism. If, for any reason, servomotor B1501 continues to rotate until the shorting roller of L1502 approaches either extreme end of travel, one of two sets of contacts of S1505 rear are shorted and the power amplifier band centering circuits recycle. Reference is made to figure 7–84 for the sequence of operation of the power amplifier band centering circuits.

a. A frequency in band 3 is to be selected.

b. Centering circuits are at rest with switches in a position corresponding to the previously selected band; band 1 in this example.

c. Voltage is available through R1518 to energize band centering mechanism. A ground circuit must be supplied before sequence relay K801 can be energized.

d. Channel is selected by operation of the channel selectors of Radio Set Control CPC–1. This operates relay K3301, which in turn grounds and energizes sequence relay K801.

e. Contacts on sequence relay K801 close to supply a ground to relay K1502.

f. Switch S1506 is rotated to the band 3 position by operation of the bandchange autopositioner and motor B103 on the front panel of the equipment.

g. Relay K1502 operates, supplying its own ground. The ground supplied by relay K801 is removed when the correct frequency is selected.

h. One side of pa chopper G601 is grounded by contacts of K1502.

i. An unbalanced voltage is fed to contacts of pa chopper G601 through the action of S1505 front and resistors R1510 through R1517.

j. Contacts of K1502 remove ground from the cathode of audio output stage V1302, muting the audio output, and open the keying circuits through contacts of relay K804 to prevent spurious radiation.

k. The unbalanced d-c voltage fed to G601 contacts causes the power amplifier servomechanism to function.

l. Operation of the power amplifier servomechanism includes rotation of servomotor B1501.

m. Rotation of B1501 drives S1505 front and rear to the band 3 position. The correct inductor and capacitor combinations are selected and the roller of L1502 is centered within the range of band 3.

n. Relay K1502 is shorted and deenergized.

7–173. PA Phase Discriminator. Refer to figure 7–82. The phase discriminator circuits employed in the power amplifier subassembly are similar to the circuits employed within the tuner subassembly, described in paragraphs 7–146 and 7–147. The major difference is the fact that the power amplifier contains high-level circuits and no voltage doubling is required. A 90-degree phase shift is obtained through capacitor C1515, paralleled by either C1512 or C1516 for bands 1 and 2, respectively. The frequencies of bands 3 and 4 are sufficiently high for a 90-degree phase shift without the use of a shunt capacitor across C1515. The capacity of neutralizing capacitor C1517 is sufficiently high at the frequencies involved that any phase shift may be ignored. The phase at the junction point of R1504 and R1503, therefore, may be considered 90 degrees with respect to the phase at the plates of the power amplifier stages. This phase relationship will exist only so long as the plates of the power amplifier stages are tuned to the same frequency as the grids. At resonance, the voltage across R1503 is equal to the voltage across R1504 and is of the opposite phase. Therefore, there will be no net voltage and the output through the parallel arrangement of R1519 and C1525 will be zero. Assume the plates of the power amplifier stages are off resonance in such a direction that the voltage across R1503 exceeds the voltage across R1504. In this case, a net current will flow through R1503, through 1507, and through CR1502, resulting in a net d-c voltage applied through the parallel arrangement of R1519 and C1525. If the plates are off resonance in such a direction that the voltage across R1504 exceeds the voltage across R1503, a net current will flow through paralleled resistors R1504 and R1524, through R1507, and through

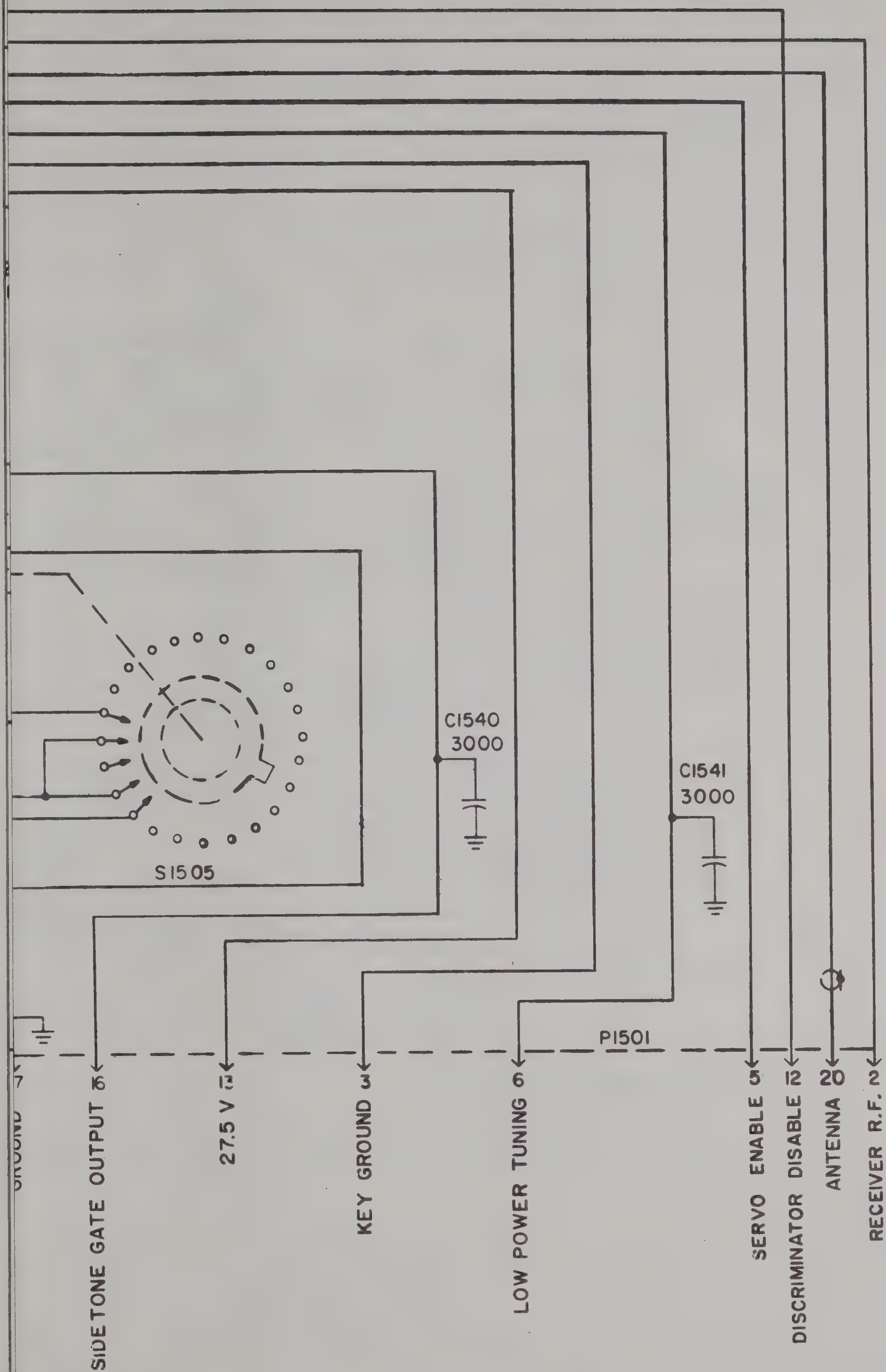


Figure 7–81. Power Amplifier Subassembly, Schematic Diagram

amplifier subassembly, the discriminator circuitry included with diode rectifiers CR1501 and CR1502, power amplifier servo motor, B1501, the table containing circuits, and detail parts listed under CC. (The power amplifier servo system will be explained in detail in paragraph 7–171.) A portion of the r-f signal across CA, L1502, CB, and LA is coupled back to the paralleled grid circuits by the capacitor combination of C1513, C1532, and C1517. The voltage is made slightly variable by capacitor C1532 and serves to neutralize the power amplifier stage. Another portion of the signal voltage is applied through the paralleled resistor combination of R1508 and R1521 to the sidetone gate control rectifier circuit. This circuit consists of R1523, L1505, C1514, R1528, and diode CR1503. The d-c output of the circuit is used to energize the sidetone gate circuit to be described in paragraph 7–246. The r-f output signal is connected through a set of contacts on antenna transfer relay K1501 and through an r-f coaxial cable to the Automatic Antenna Tuner 180L–3, which in turn couples the r-f signal to the antenna.

7–172. Band Centering Circuits. Reference is made to the simplified schematic diagram, figure 7–82. Rough tuning of the power amplifier subassembly consists of selecting the proper network values of inductance and capacitance for the band selected. Switches S1501 through S1504 perform these functions. Switches S1501 through S1504 and S1506 are operated by the band selector autopositioner motor, B103. Switches S1506 and S1505 and the associated circuits perform the function of placing the roller of main tuning inductor L1502 to the center position of the band selected. Figure 7–83 illustrates the approximate tuning ranges for each band. The rear section of switch S1505 serves as a protective stop mechanism. If, for any reason, servomotor B1501 continues to rotate until the shorting roller of L1502 approaches either extreme end of travel, one of two sets of contacts of S1505 rear are shorted and the power amplifier band centering circuits recycle. Reference is made to figure 7–84 for the sequence of operation of the power amplifier band centering circuits.

a. A frequency in band 3 is to be selected.

b. Centering circuits are at rest with switches in a position corresponding to the previously selected band; band 1 in this example.

c. Voltage is available through R1518 to energize band centering mechanism. A ground circuit must be supplied before sequence relay K801 can be energized.

d. Channel is selected by operation of the channel selectors of Radio Set Control CPC–1. This operates relay K3301, which in turn grounds and energizes sequence relay K801.

e. Contacts on sequence relay K801 close to supply a ground to relay K1502.

f. Switch S1506 is rotated to the band 3 position by operation of the bandchange autopositioner and motor B103 on the front panel of the equipment.

g. Relay K1502 operates, supplying its own ground. The ground supplied by relay K801 is removed when the correct frequency is selected.

h. One side of pa chopper G601 is grounded by contacts of K1502.

i. An unbalanced voltage is fed to contacts of pa chopper G601 through the action of S1505 front and resistors R1510 through R1517.

j. Contacts of K1502 remove ground from the cathode of audio output stage V1302, muting the audio output, and open the keying circuits through contacts of relay K804 to prevent spurious radiation.

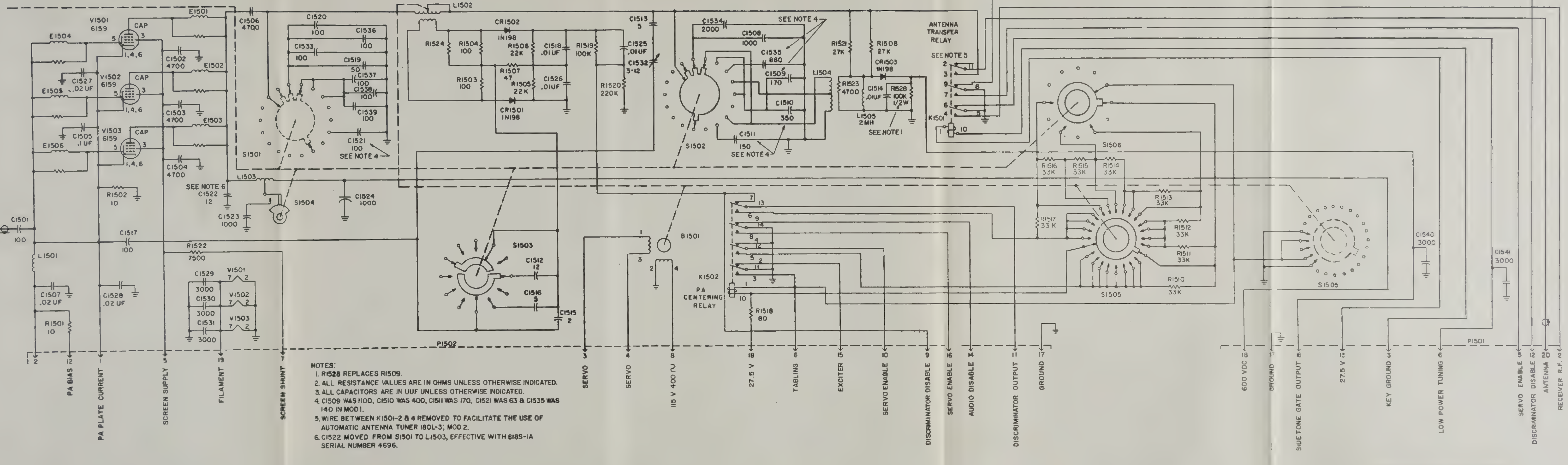
k. The unbalanced d-c voltage fed to G601 contacts causes the power amplifier servomechanism to function.

l. Operation of the power amplifier servomechanism includes rotation of servomotor B1501.

m. Rotation of B1501 drives S1505 front and rear to the band 3 position. The correct inductor and capacitor combinations are selected and the roller of L1502 is centered within the range of band 3.

n. Relay K1502 is shorted and deenergized.

7–173. PA Phase Discriminator. Refer to figure 7–82. The phase discriminator circuits employed in the power amplifier subassembly are similar to the circuits employed within the tuner subassembly, described in paragraphs 7–146 and 7–147. The major difference is the fact that the power amplifier contains high-level circuits and no voltage doubling is required. A 90-degree phase shift is obtained through capacitor C1515, paralleled by either C1512 or C1516 for bands 1 and 2, respectively. The frequencies of bands 3 and 4 are sufficiently high for a 90-degree phase shift without the use of a shunt capacitor across C1515. The capacity of neutralizing capacitor C1517 is sufficiently high at the frequencies involved that any phase shift may be ignored. The phase at the junction point of R1504 and R1503, therefore, may be considered 90 degrees with respect to the phase at the plates of the power amplifier stages. This phase relationship will exist only so long as the plates of the power amplifier stages are tuned to the same frequency as the grids. At resonance, the voltage across R1503 is equal to the voltage across R1504 and is of the opposite phase. Therefore, there will be no net voltage and the output through the parallel arrangement of R1519 and C1525 will be zero. Assume the plates of the power amplifier stages are off resonance in such a direction that the voltage across R1503 exceeds the voltage across R1504. In this case, a net current will flow through R1503, through 1507, and through CR1502, resulting in a net d-c voltage applied through the parallel arrangement of R1519 and C1525. If the plates are off resonance in such a direction that the voltage across R1504 exceeds the voltage across R1503, a net current will flow through paralleled resistors R1504 and R1524, through R1507, and through



NOTES:

1. R1528 REPLACES R1509.
2. ALL RESISTANCE VALUES ARE IN OHMS UNLESS OTHERWISE INDICATED.
3. ALL CAPACITORS ARE IN UUF UNLESS OTHERWISE INDICATED.
4. C1509 WAS 1100, C1510 WAS 400, C1511 WAS 170, C1521 WAS 63 & C1535 WAS 140 IN MOD 1.
5. WIRE BETWEEN K1501-2 & 4 REMOVED TO FACILITATE THE USE OF AUTOMATIC ANTENNA TUNER 180L-3; MOD 2.
6. C1522 MOVED FROM S1501 TO L1503, EFFECTIVE WITH 618S-1A SERIAL NUMBER 4696.

Figure 7-81. Power Amplifier Subassembly, Schematic Diagram

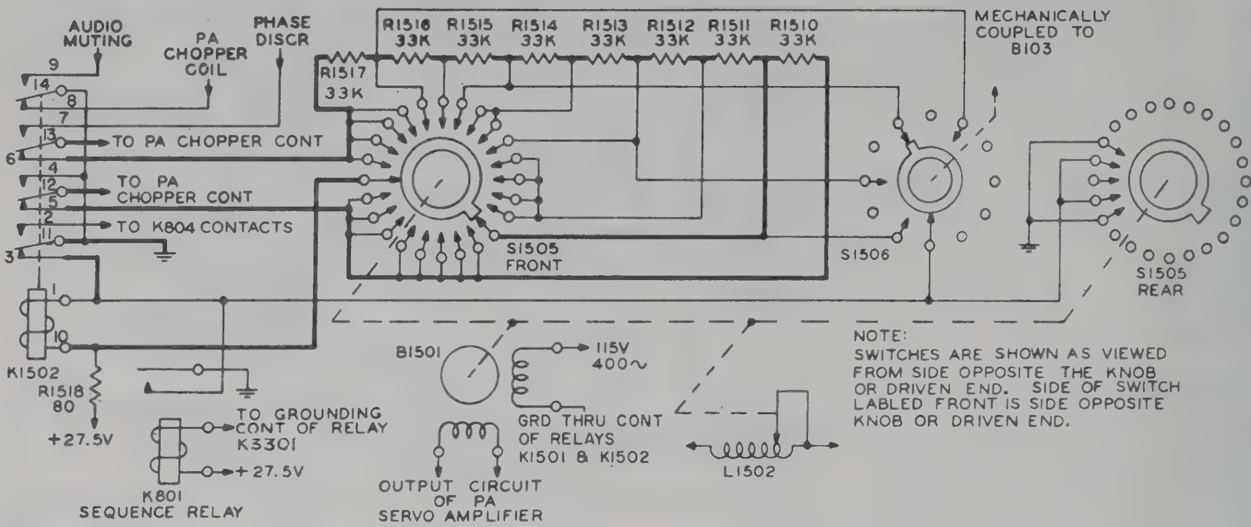


Figure 7-84. Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Sheet 3 of 4)

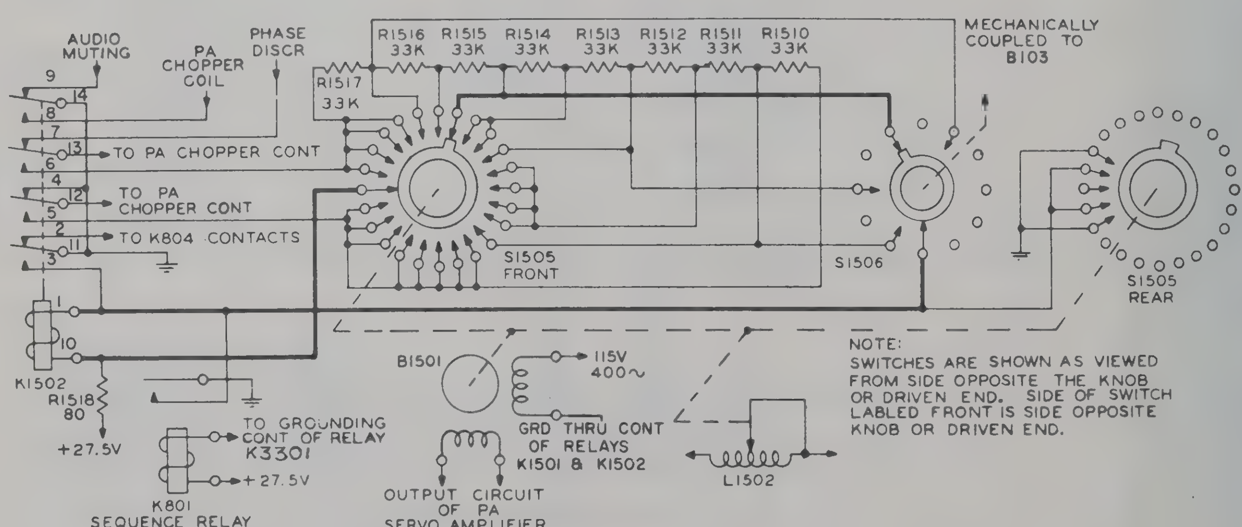
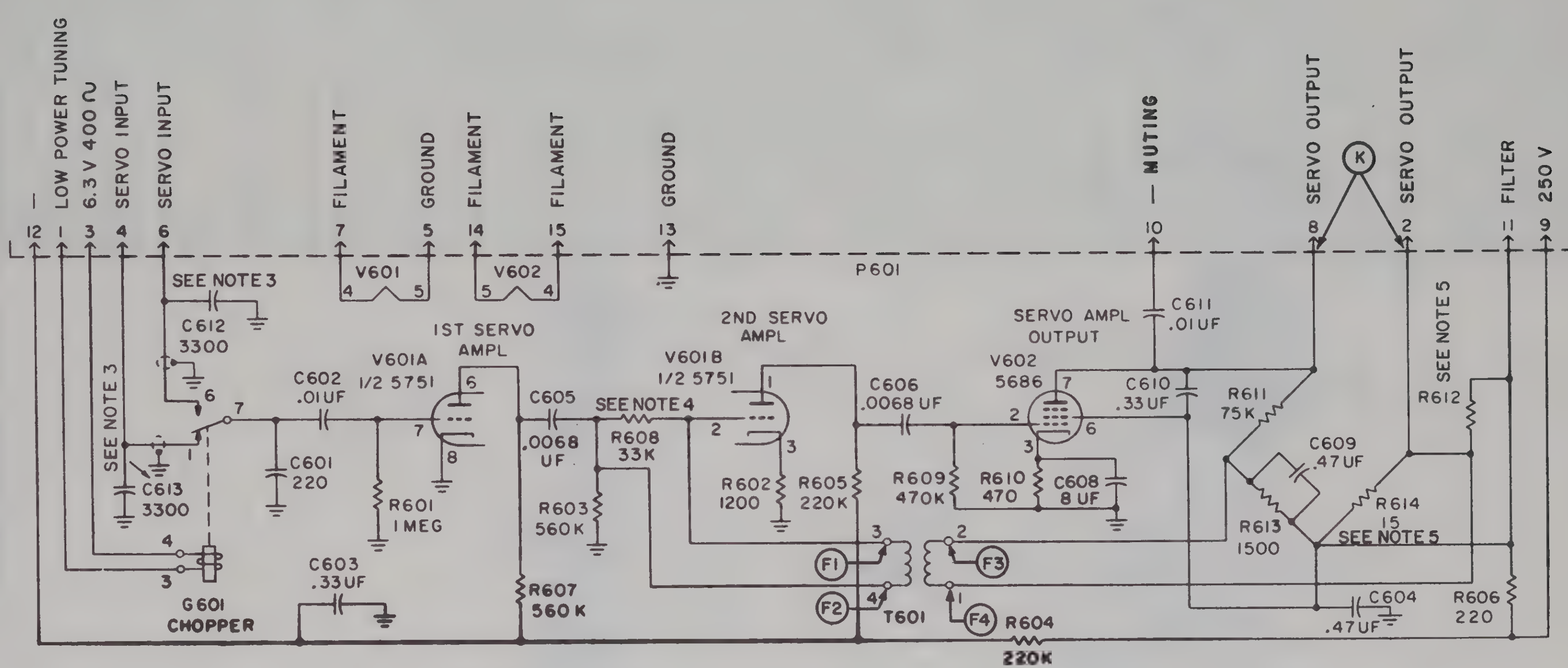


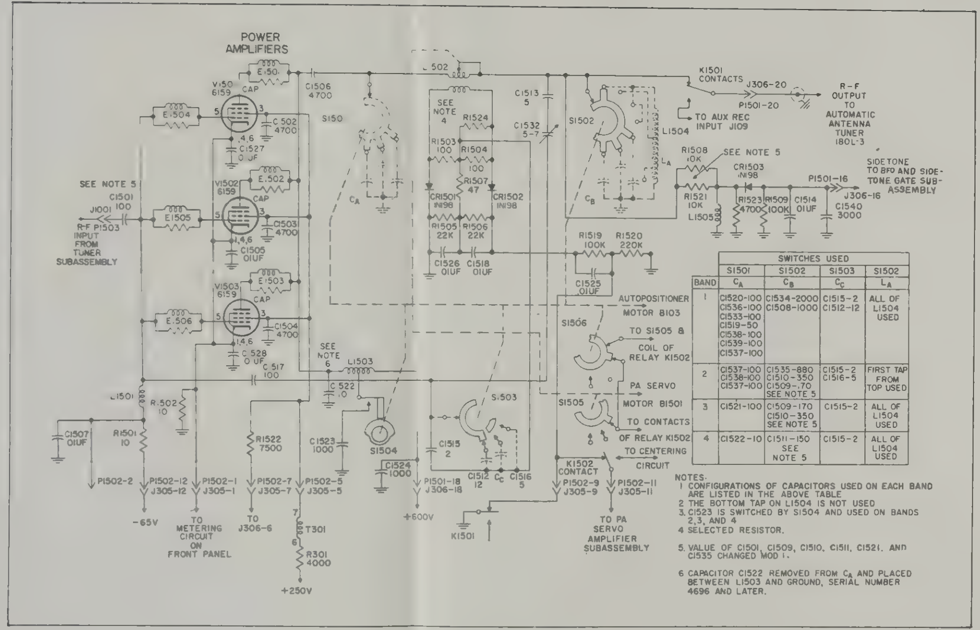
Figure 7-84. Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Sheet 4 of 4)



NOTES:

1. ALL RESISTANCE VALUES ARE IN OHMS UNLESS OTHERWISE INDICATED.
2. ALL CAPACITORS ARE IN UUF UNLESS OTHERWISE INDICATED.
3. VALUE OF C612 & C613 CHANGED FROM 3000 TO 3300; MOD 3 OF PA SERVO AMPLIFIER.
4. VALUE OF R608 CHANGED FROM 68K TO 33K; MOD 2 OF PA SERVO AMPLIFIER.
5. VALUE OF R614 CHANGED FROM 10 TO 15 AND R612 ADDED; VALUE OF R612 IS SELECTED, REFER TO T.O. 12R2-4-6-4; MOD 1 OF PA SERVO AMPLIFIER.

Figure 7–85. PA Servo Amplifier Subassembly, Schematic Diagram



	SWITCHES USED			
	S1501	S1502	S1503	S1502
BAND	C_A	C_B	C_C	L_A
1	C1520-100 C1536-100 C1533-100 C1519-50 C1538-100 C1539-100 C1537-100	C1534-2000 C1508-1000	C1515-2 C1512-12	ALL OF L1504 USED
2	C1537-100 C1538-100 C1537-100	C1535-880 C1510-350 C1509-.70 SEE NOTE 5	C1515-2 C1516-5	FIRST TAP FROM TOP USED
3	C1521-100	C1509-170 C1510-350 SEE NOTE 5	C1515-2	ALL OF L1504 USED
4	C1522-10	C1511-150 SEE NOTE 5	C1515-2	ALL OF L1504 USED

NOTES:
1. CONFIGURATIONS OF CAPACITORS USED ON EACH BAND ARE LISTED IN THE ABOVE TABLE
2. THE BOTTOM TAP ON L1504 IS NOT USED
3. C1523 IS SWITCHED BY S1504 AND USED ON BANDS 2, 3, AND 4
4. SELECTED RESISTOR.
5. VALUE OF C1501, C1509, C1510, C1511, C1521, AND C1535 CHANGED MOD 1.
6. CAPACITOR C1522 REMOVED FROM C_A AND PLACED BETWEEN L1503 AND GROUND, SERIAL NUMBER 4696 AND LATER.

Figure 7–82. Power Amplifier Subassembly, Simplified Schematic Diagram

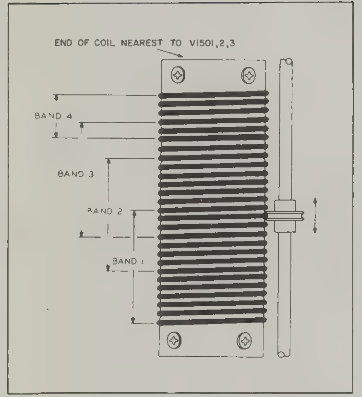


Figure 7–83. Inductor L1502, Approximate Tuning Ranges, Functional Diagram

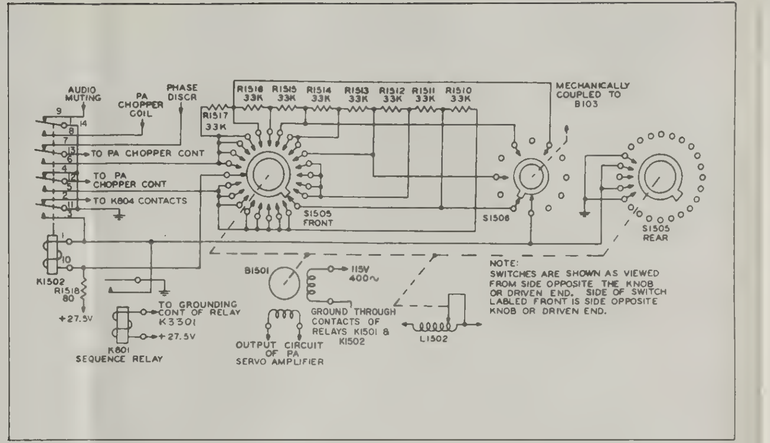


Figure 7–84. Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Sheet 1 of 4)

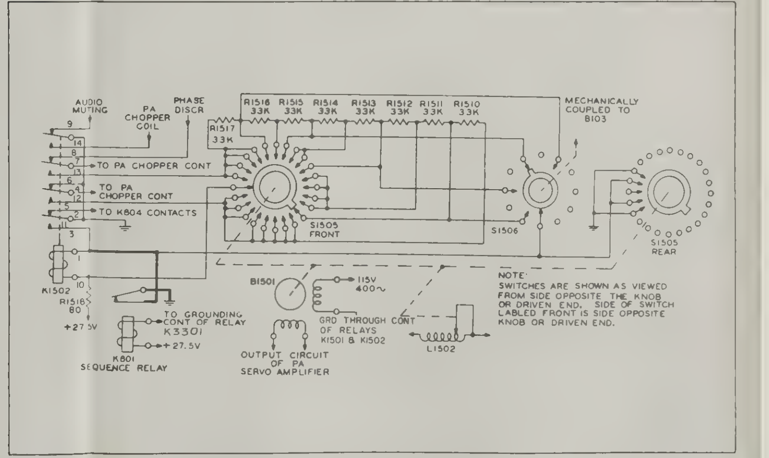


Figure 7–84. Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Sheet 2 of 4)

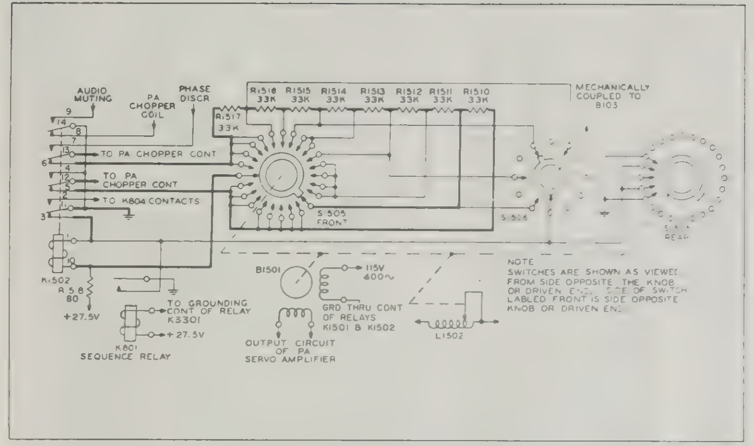


Figure 7–84. Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Sheet 3 of 4)

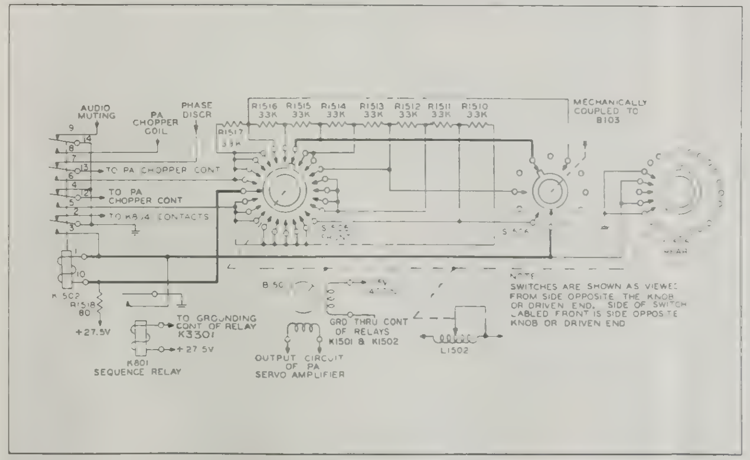
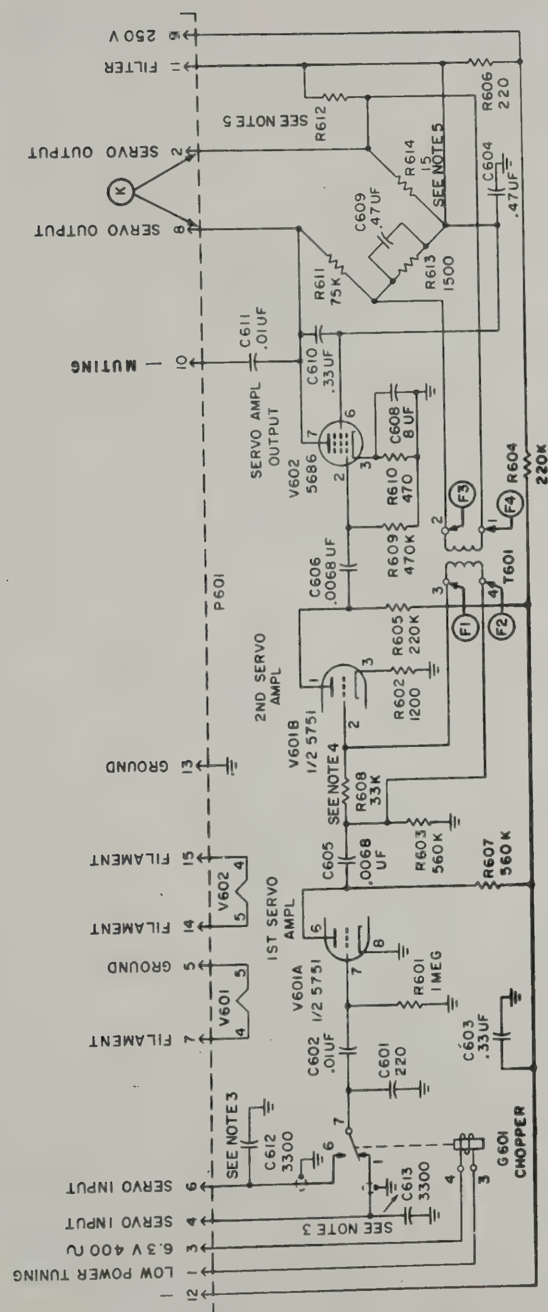


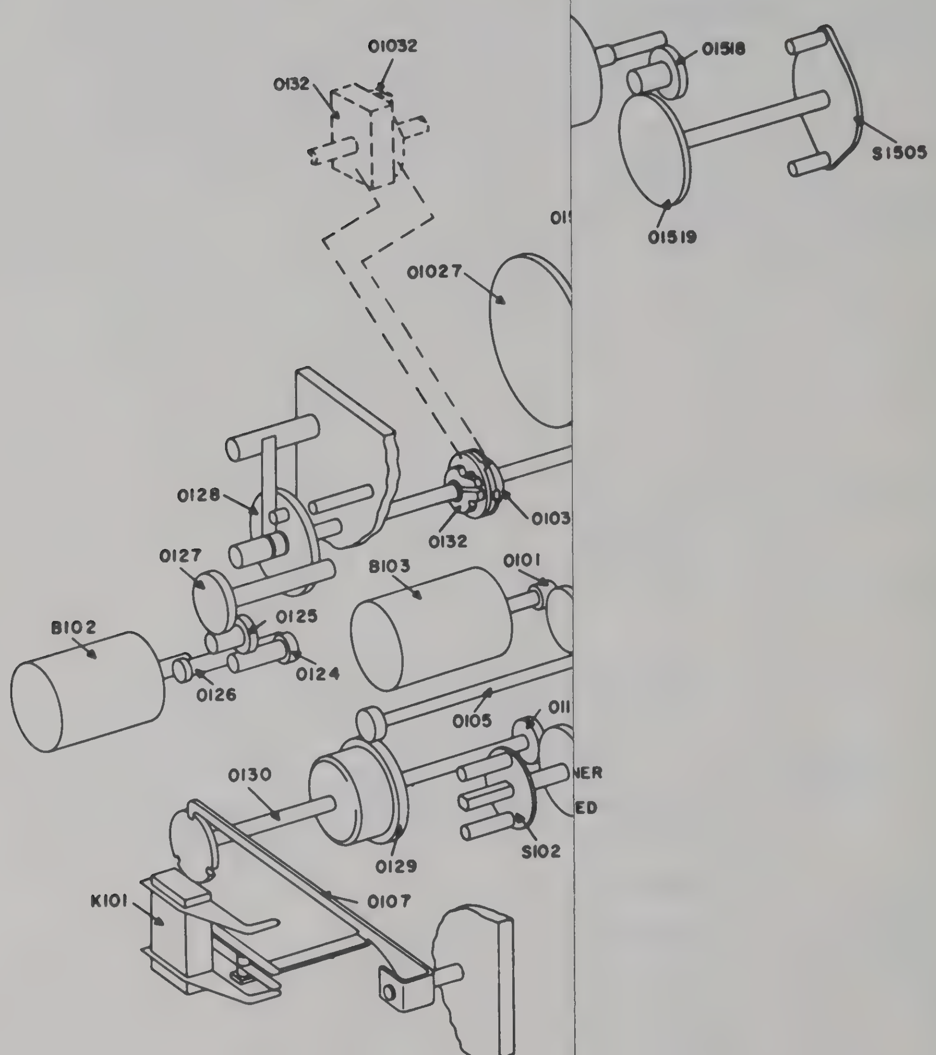
Figure 7–84. Power Amplifier Band Centering Circuit, Simplified Schematic Diagram (Sheet 4 of 4)



NOTES:

1. ALL RESISTANCE VALUES ARE IN OHMS UNLESS OTHERWISE INDICATED.
2. ALL CAPACITORS ARE IN UUF UNLESS OTHERWISE INDICATED.
3. VALUE OF C612 & C613 CHANGED FROM 3000 TO 3300; MOD 3 OF PA SERVO AMPLIFIER.
4. VALUE OF R608 CHANGED FROM 68K TO 33K; MOD 2 OF PA SERVO AMPLIFIER.
5. VALUE OF R614 CHANGED FROM 10 TO 15 AND R612 ADDED; VALUE OF R612 IS SELECTED, REFER TO T.O. 12R2-~~4-6-4~~; MOD 1 OF PA SERVO AMPLIFIER.

Figure 7-85. PA Servo Amplifier Subassembly, Schematic Diagram



nel Mechanical

CR1501. The output through R1519 and C1525 would be a d-c voltage of the opposite polarity. Thus, the output of the power amplifier phase discriminator is a d-c voltage, polarity dependent upon the direction off resonance and amplitude dependent upon the magnitude of the frequency error. The output d-c voltage is developed across resistor R1520. The time constant formed by R1519 and C1525 prevents over-correction or hunting while not destroying the sensitivity of the frequency correction circuits. The output voltage is grounded through contacts of antenna transfer relay K1501 except during channeling or when the transmitter is keyed. This prevents the power amplifier correction circuits from operating during reception. The d-c output is applied through contacts of relay K1502 to contacts of chopper G601 within the pa servo amplifier subassembly. Relay K1502 is energized during centering operations of the power amplifier subassembly, thus preventing the setup circuits from operating during the centering cycle. The servo amplifier subassembly employed within the power amplifier correction circuits is identical to the one used for the tuner subassembly, described in paragraph 7-157. In this case, servomotor G1501 is employed, and the roller of L1502 is set up rather than the tuner slugs. The pa servo amplifier and the tuner servo amplifier subassemblies are interchangeable without wiring changes. During the trouble isolation procedures, this interchangeability may be helpful.

7-174. PA SERVO AMPLIFIER SUBASSEMBLY.

7-175. GENERAL DATA. The pa servo amplifier subassembly is identical to and interchangeable with the tuner servo amplifier subassembly. It functions to control the servomotor (B1501) operation which is used to tune the power amplifier. Therefore, when troubleshooting the pa servo amplifier subassembly, the complete pa servo system must be considered. Reference must be made to paragraphs 4-32 and 7-157 in order to fully understand the operation of this subassembly. As the circuits in the subassembly are identical to those in the tuner servo amplifier subassembly, the minimum performance standards, check-out or analysis, removal and replacement, alinement and adjustment, and detailed circuit analysis details described in paragraps 7-150 through 7-157 are identical. The schematic diagram of figure 7-85 is the same as that of figure 7-71 except for the circuit terminations at the pins of P601.

7-176. TUNER AND POWER AMPLIFIER MECHANICAL FUNCTIONS.

7-177. BAND SELECTION. Refer to figure 7-86. Motor B103 is energized by operation of the channel selector of Radio Set Control CPC-1, as described in paragraph 7-74. Relay K101 is energized and pawl O107 is lifted from its stop wheel. The drive is transmitted through gears O101, O103, O109, O129, O112, and O113. Band selector switches S1002 and S1001 are rotated, selecting the correct tuned circuits. The drive is transferred through gears O1021, O1024, and O1022 for band selector switches S1003 through S1006, S1501 through S1504, and S1506. Seeking switch S102 is driven until an open circuit is reached, at which time relay K101 is de-energized and the proper band is selected.

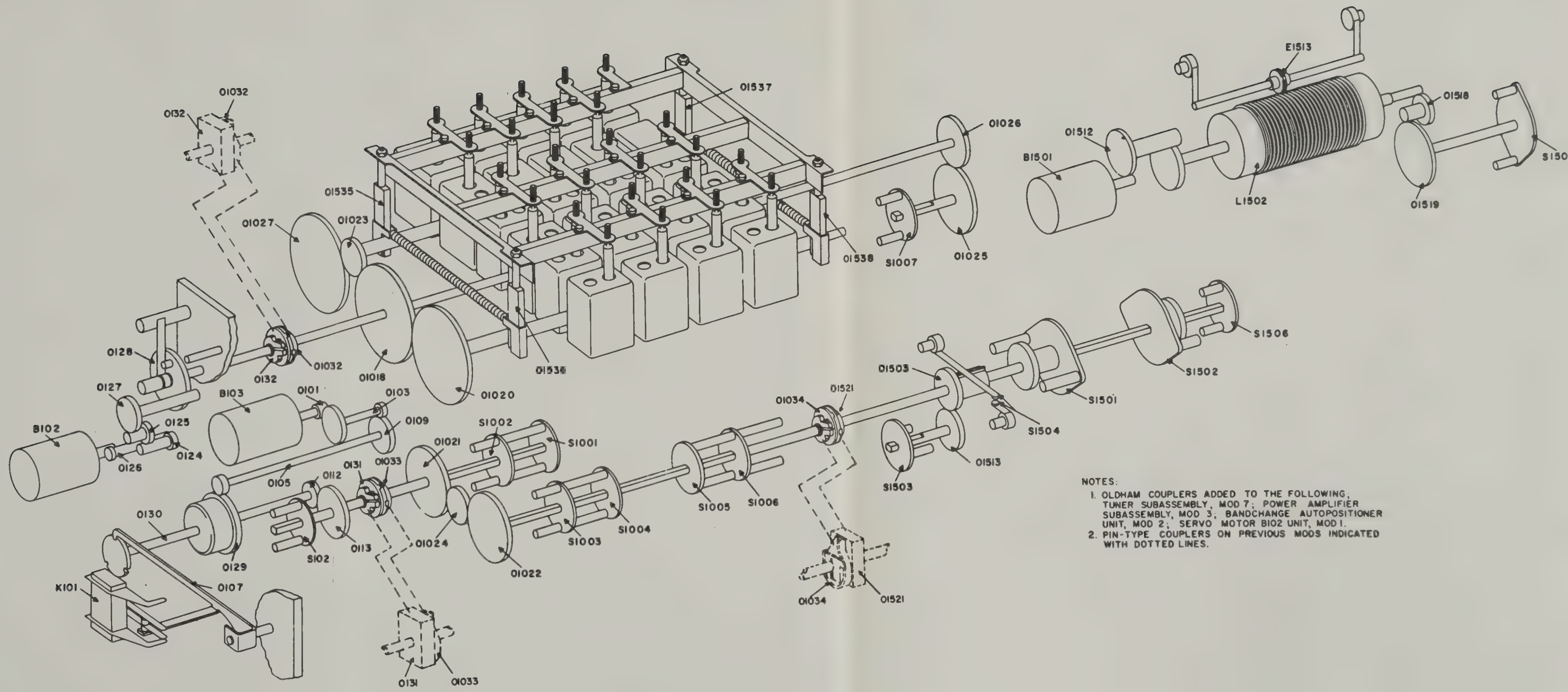
7-178. TUNER FUNCTIONS. Servomotor B102 is energized through the tuner table centering circuits, as described in paragraph 7-146. The drive from B102 is transferred through gears O124 through O128, and through coupler O132 to the main tuning shaft. Gears O1020 and O1027 are driven, driving the tuner slugs toward the center position. Switch S1007 is driven through gears O1026 and O1025 to an open circuit position, reached when the tuner slugs are in the center of their respective inductors. The tuner centering circuits are deenergized and motor B102 is driven through the tuner discriminator action described in paragraphs 7-146 and 7-147. The slugs of the tuner subassembly are driven to the setup position by gears O1020 and O1027, at which time the tuner discriminator circuits are satisfied and servomotor B102 is deenergized. The action of relay K3301 prevents B102 from being energized through switch S1007 after the tuner slugs have been set up as described in paragraph 7-146. Relay K3301 is energized only during the channeling cycle of the cmo, thus energizing the tuner centering circuits and B102 only when centering is required.

7-179. POWER AMPLIFIER FUNCTIONS. Switch S1506 operates whenever the band is changed, thus energizing the centering circuits of the power amplifier subassembly. Servomotor B1501 drives roller E1513 to the center position of the band selected on main-tuning inductor L1502. The centering circuits are deenergized when switch S1505 is driven to the correct position and the power amplifier discriminator circuits are free to operate. Servomotor B1501 is driven through the action of the power amplifier discriminator, and roller E1513 is driven to the setup position on L1502. The action of sequence relay K801, described in figure 7-84, prevents the centering and setup functions from overlapping. Gears O1512, O1518, and O1519 couple the drive from B1501 to main tuning inductor L1502 and switch S1505 in figure 7-86.

7-180. MODULATOR SUBASSEMBLY.

7-181. GENERAL DATA. The modulator subassembly contains the microphone input amplifier, speech clipper and filter, single-sideband generator, carrier insert control, and automatic-level-control (alc) circuits. This subassembly should always be checked when improper operation is caused by low or no modulation, or when operating in the cw mode, non-insertion of the 250-kc carrier. As no lubrication is required by this subassembly, the lubrication paragraph has been omitted.

7-182. MINIMUM PERFORMANCE STANDARDS. The modulator subassembly obtains its plate voltage from the dynamotor, therefore, measurements can only be made when the equipment is operating in



NOTES:

1. OLDHAM COUPLERS ADDED TO THE FOLLOWING; TUNER SUBASSEMBLY, MOD 7; POWER AMPLIFIER SUBASSEMBLY, MOD 3; BANDCHANGE AUTOPOSITIONER UNIT, MOD 2; SERVO MOTOR B102 UNIT, MOD 1.
2. PIN-TYPE COUPLERS ON PREVIOUS MODS INDICATED WITH DOTTED LINES.

Figure 7–86. Tuner, Power Amplifier, and Front Panel Mechanical Functional Diagram

CR1501. The output through R1519 and C1525 would be a d-c voltage of the opposite polarity. Thus, the output of the power amplifier phase discriminator is a d-c voltage, polarity dependent upon the direction off resonance and amplitude dependent upon the magnitude of the frequency error. The output d-c voltage is developed across resistor R1520. The time constant formed by R1519 and C1525 prevents over-correction or hunting while not destroying the sensitivity of the frequency correction circuits. The output voltage is grounded through contacts of antenna transfer relay K1501 except during channeling or when the transmitter is keyed. This prevents the power amplifier correction circuits from operating during reception. The d-c output is applied through contacts of relay K1502 to contacts of chopper G601 within the pa servo amplifier subassembly. Relay K1502 is energized during centering operations of the power amplifier subassembly, thus preventing the setup circuits from operating during the centering cycle. The servo amplifier subassembly employed within the power amplifier correction circuits is identical to the one used for the tuner subassembly, described in paragraph 7-157. In this case, servomotor G1501 is employed, and the roller of L1502 is set up rather than the tuner slugs. The pa servo amplifier and the tuner servo amplifier subassemblies are interchangeable without wiring changes. During the trouble isolation procedures, this interchangeability may be helpful.

7-174. PA SERVO AMPLIFIER SUBASSEMBLY.

7-175. GENERAL DATA. The pa servo amplifier subassembly is identical to and interchangeable with the tuner servo amplifier subassembly. It functions to control the servomotor (B1501) operation which is used to tune the power amplifier. Therefore, when troubleshooting the pa servo amplifier subassembly, the complete pa servo system must be considered. Reference must be made to paragraphs 4-32 and 7-157 in order to fully understand the operation of this subassembly. As the circuits in the subassembly are identical to those in the tuner servo amplifier subassembly, the minimum performance standards, check-out or analysis, removal and replacement, alinement and adjustment, and detailed circuit analysis details described in paragraps 7-150 through 7-157 are identical. The schematic diagram of figure 7-85 is the same as that of figure 7-71 except for the circuit terminations at the pins of P601.

7-176. TUNER AND POWER AMPLIFIER MECHANICAL FUNCTIONS.

7-177. BAND SELECTION. Refer to figure 7-86. Motor B103 is energized by operation of the channel selector of Radio Set Control CPC-1, as described in paragraph 7-74. Relay K101 is energized and pawl O107 is lifted from its stop wheel. The drive is transmitted through gears O101, O103, O109, O129, O112, and O113. Band selector switches S1002 and S1001 are rotated, selecting the correct tuned circuits. The drive is transferred through gears O1021, O1024, and O1022 for band selector switches S1003 through S1006, S1501 through S1504, and S1506. Seeking switch S102 is driven until an open circuit is reached, at which time relay K101 is de-energized and the proper band is selected.

7-178. TUNER FUNCTIONS. Servomotor B102 is energized through the tuner table centering circuits, as described in paragraph 7-146. The drive from B102 is transferred through gears O124 through O128, and through coupler O132 to the main tuning shaft. Gears O1020 and O1027 are driven, driving the tuner slugs toward the center position. Switch S1007 is driven through gears O1026 and O1025 to an open circuit position, reached when the tuner slugs are in the center of their respective inductors. The tuner centering circuits are deenergized and motor B102 is driven through the tuner discriminator action described in paragraphs 7-146 and 7-147. The slugs of the tuner subassembly are driven to the setup position by gears O1020 and O1027, at which time the tuner discriminator circuits are satisfied and servomotor B102 is deenergized. The action of relay K3301 prevents B102 from being energized through switch S1007 after the tuner slugs have been set up as described in paragraph 7-146. Relay K3301 is energized only during the channeling cycle of the cmo, thus energizing the tuner centering circuits and B102 only when centering is required.

7-179. POWER AMPLIFIER FUNCTIONS. Switch S1506 operates whenever the band is changed, thus energizing the centering circuits of the power amplifier subassembly. Servomotor B1501 drives roller E1513 to the center position of the band selected on main-tuning inductor L1502. The centering circuits are deenergized when switch S1505 is driven to the correct position and the power amplifier discriminator circuits are free to operate. Servomotor B1501 is driven through the action of the power amplifier discriminator, and roller E1513 is driven to the setup position on L1502. The action of sequence relay K801, described in figure 7-84, prevents the centering and setup functions from overlapping. Gears O1512, O1518, and O1519 couple the drive from B1501 to main tuning inductor L1502 and switch S1505 in figure 7-86.

7-180. MODULATOR SUBASSEMBLY.

7-181. GENERAL DATA. The modulator subassembly contains the microphone input amplifier, speech clipper and filter, single-sideband generator, carrier insert control, and automatic-level-control (alc) circuits. This subassembly should always be checked when improper operation is caused by low or no modulation, or when operating in the cw mode, non-insertion of the 250-kc carrier. As no lubrication is required by this subassembly, the lubrication paragraph has been omitted.

7-182. MINIMUM PERFORMANCE STANDARDS. The modulator subassembly obtains its plate voltage from the dynamotor, therefore, measurements can only be made when the equipment is operating in

the transmit mode. All checks are to be made with the subassembly connected into a bench test setup similar to the one shown in figure 2–2 with the equipment tuned to a frequency of 14,249.5 kc ("TCZZ").

CAUTION

The maximum duty cycle of the transmitter section of this equipment (and antenna tuner, if used) is five minutes. Never hold the telegraph key or microphone press-to-talk button closed continuously or operate a teletypewriter in excess of five minutes or major damage to the equipment could result. If, while performing tests, the transmitter is keyed continuously for this length of time, allow a minimum of five minutes to elapse in the unkeyed condition in order to permit the equipment to return to normal operating temperature before proceeding.

a. Remove the subassembly from the main frame as outlined in paragraph 7–184.

b. Connect the subassembly to the main frame by means of the 15-pin extension cable fabricated as described in paragraph 3–7.

c. Remove the excitation cable plug (P1503) from the tuner subassembly jack ("J1001").

d. Connect the output of the TS-382/U audio oscillator to the "MIC" input jack as shown in figure 2–2. Set the output frequency to 1000 cps at a level of 0.25 volt rms as measured at the microphone jack.

e. Rotate the clipper control ("R1404") to its maximum clockwise rotation.

f. Connect the a-c probe of the vtvm to pin 11 of P1401.

g. Operate the function switch on Radio Set Control CPC–1 to the "SSB/FSK" position and allow the equipment to warm up for a minimum of ten minutes.

h. Key the transmitter and note the reading on the vtvm. If necessary, adjust the gain control ("R1403") until a reading of 1.4 volts rms is obtained. This reading will be obtained from a normally operating subassembly at approximately two-thirds clockwise rotation of the gain control.

i. Rotate the clipping level control ("R1404") in a counterclockwise direction while observing the output level. If the clipping control circuit is performing normally, a point will be reached where the output level starts to decrease. This is the proper setting for this control. The start of the clipping action can be observed more accurately by connecting the oscilloscope probe to pin 6 of P1401.

j. Release the transmitter key and connect the vtvm probe to the dummy load.

k. Reconnect the excitation cable plug (P1503) to the tuner subassembly jack ("J1001").

l. Set the range switch on the vtvm to the 100-volt scale.

m. Rotate the gain control to maximum counterclockwise rotation.

n. Adjust the output level of the audio oscillator to .5 volts rms as measured across the microphone jack.

o. Key the transmitter and gradually increase the gain control setting until the vtvm indicates a reading of 70 volts rms.

p. Remove the 1000 cps input from the microphone input with the transmitter still keyed. Ground the microphone input through a 150 uuf capacitor.

q. Increase the sensitivity of the vtvm until a reading is obtained. If the balanced modulator circuit is functioning normally, a reading of less than 0.7 volts rms will be obtained. This represents a minimum of 40 db of carrier suppression. If this minimum is not obtained, the balance control ("R1430") may require readjustment.

CAUTION

This measurement must be accomplished as quickly as possible as no alc bias will be developed. Therefore, power amplifier tube screen dissipation will be dangerous. Alc bias is only developed when a complex signal (two or more tones) is present.

r. Release the key of the transmitter and reconnect the vtvm probe to pin 11 of P1401, and the output of the audio oscillator to the "MIC" input jack.

s. Adjust the output level of the audio oscillator to 0.25 volt rms as measured across the microphone jack.

t. Key the transmitter and readjust the gain control until a reading of 1.4 volt rms is obtained.

u. Release the transmitter key and connect the vtvm probe to "J1401".

v. Set the function switch on the radio set control to the "AME" position.

w. Key the transmitter and note the reading on the vtvm. A minimum reading of +10 volts should be obtained if the ame control circuit bias assembly (Z1401) is functioning normally. When the audio input is disabled, the voltage should decrease to approximately zero.

7–183. CHECK-OUT OR ANALYSIS. The respective circuits of this subassembly should be checked whenever there is a loss of carrier, or improper and distorted modulation, while transmitting in the cw, ssb, or ame modes. Furthermore, any variation in the modulation level of the transmission could be caused by a defect in the alc control stage in this subassembly or its bias source located in the reference oscillator subassembly (paragraph 7–105). Before performing any of the trouble isolation procedures outlined in figure 7–87, test all tubes and check the gain ("R1403"), clipping ("R1404"), and carrier conrol ("R1430") settings for proper adjustment as described in paragraphs 7–185 through 7–187. Figure 7–91 is the sche-

matic diagram and figures 7-89 and 7-90 show the subassembly alinement and level adjustment locations. After isolation of the defective stage, voltage and resistance measurements should be made and compared with those shown in figure 7-88 in order to isolate the defective detail parts. All of the checks listed in figure 7-87 are made with the radio set tuned to 14,249.5 kc ("TCZZ") and with the plug (P1503) removed from the jack ("J1001") located on the tuner subassembly. The subassembly must be removed from the main chassis as described in paragraph 7-184 and reconnected to the main chassis receptacle by means of a 15-pin extension cable.

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
1	1, 5, 6	Bird Model 82 Dummy Load, VTVM TS-375/U telegraph key or microphone connected as shown in figure 2-2.	Set function switch on Radio Set Control CPC-1 to "CW" position and "CHANNEL" select switches to "BKBB" (2.0 mc). Key transmitter and note vtvm reading.	70 volts rms minimum. Proceed to step 5.	1a. Check V1407 and V1408. 1b. Check V1407 and V1408 and all associated voltages and resistances and compare with those of figure 7-88. 1c. Check all parts associated with abnormal voltage and resistance measurements. 1d. Check operation of K301 located in the main chassis and K803 in the relay subassembly. Proceed to step 2.
2	G2	VTVM TS-375/U.	Connect vtvm to pin 1 of P1401. All other procedures as described in step 1.	5 to 8 volts rms.	2a. Check reference oscillator subassembly as described in paragraph 7-105. 2b. Check T1401, C1433 and C1437 for short or open circuits. Proceed to step 3.
3	"J1401"	VTVM TS-375/U.	Connect vtvm to "J1401".	+10 volts minimum.	3a. Check assembly Z1401. Proceed to step 4.
4	4	Headset.	Same as step 1 except note tone in headset.	400 cps tone clearly audible.	4a. Check V1401 and V1402 and all associated voltages and resistances and compare with those of figure 7-88. 4b. Check all parts associated with abnormal voltage and resistance measurements. 4c. Check bfo and sidetone gate subassembly as outlined in paragraph 7-239.
5	1	Bird Model 82 Dummy Load, VTVM TS-375/U Audio Oscillator TS-382/U, dummy microphone, Oscilloscope TEK-545 and a 25 uuf capacitor connected as shown in figure 2-2.	Set function switch on Radio Set Control CPC-1 to "AME" position and "CHANNEL" select switches to "TCZZ" (14.2495 mc). Adjust audio oscillator to 1000 cps at an output of 0.46 volt rms and oscilloscope for horizontal sweep of two or three modulated waveforms. Key transmitter.	100-percent modulated waveform, free of peak clipping as observed on TEK-545, and minimum of 50 volts rms on vtvm. Proceed to step 6.	5a. Adjust "R1437" for 100-percent modulated waveform as described in paragraph 7-187. 5b. Check as outlined in steps 1a through 4c. Proceed to step 6.

Figure 7-87. Modulator Subassembly Trouble Analysis Chart (Sheet 1 of 3)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
6	"J1402" 5	Microphone and VTVM TS-375/U.	Connect vtvm to "J1402" and disconnect audio oscillator from "MIC" input. Plug in microphone and talk with varying amplitude into microphone while watching vtvm and oscilloscope.	Modulated waveform as observed on oscilloscope and varying negative voltage (−2 volts minimum) on vtvm. This voltage should vary with voice amplitude, higher for loud voice, lower for low voice input.	6a. Check alc bias circuit in reference oscillator subassembly as described in paragraph 7-105. 6b. Check all associated main chassis interconnections.
7	1	Bird Model 82 Dummy Load, VTVM TS-375/U, two Audio Oscillators TS-382/U, dummy microphone, Oscilloscope TEK-545, 25 uuf capacitor, telegraph key.	Set function switch on Radio Set Control CPC-1 to "SSB/FSK" position and "CHANNEL" select switches to "TCZZ" (14.2495 mc). Adjust one audio oscillator to a frequency of 1000 cps, and the second to 1700 cps with output levels of 0.23 volt rms as measured across microphone jack. Set oscilloscope horizontal sweep for two or three modulated waveform patterns and key transmitter.	100-percent modulated wave form free of peak clipping and 50 volts rms. Proceed to step 10.	Proceed to step 8.
8	G3	VTVM TS-375/U.	Connect vtvm to pin 11 of P1401. All other conditions remain as in step 7.	1.4 volts rms with gain control (R1403) set at approximately two-thirds clockwise rotation.	8a. Check all parts as described in steps 1a through 4c. 8b. Check V1406 and associated voltages and resistances as shown in figure 7-88. 8c. Check all parts asociated with abnormal voltage and resistance readings. Proceed to step 9.
9	G1	VTVM TS-375/U.	Connect vtvm to pin 6 of P1401. All other conditions remain as in step 7.	2.03 volts rms with "R1403" set at approximately two-thirds clockwise rotation.	9a. Check V1401, V1402, and all associated voltages and resistances as shown in figure 7-88. 9b. Check all parts associated with abnormal measurements.
10	Same as step 7.	Same as step 7.	Same as step 7 except disable output of audio oscillators and ground microphone input, through a 150 uuf capacitor.	0.7 volt rms maximum.	10a. Readjust "R1430" as outlined in paragraph 7-186. 10b. Check V1406 and all associated voltages and resistances as shown in figure 7-88.

Figure 7-87. Modulator Subassembly Trouble Analysis Chart (Sheet 2 of 3)

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
10 (cont)					10c. Check FL1401, T1401, and all associated parts. 10d. Check operation of K1401. 10e. Check CR1401 for quality. 10f. Check for hum on 27.5-volt d-c line to microphone. Proceed to step 11.
11	G2	VTVM TS-375/U.	Connect vtvm to pin 1 of P1401.	5 to 8 volts rms.	11a. Check 250-kc output of reference oscillator subassembly as described in paragraph 7-105. 11b. Check all main chassis interconnections between 250-kc output of reference oscillator subassembly and modulator subassembly.

7-87. Modulator Subassembly Trouble Analysis Chart (Sheet 3 of 3)

V1401

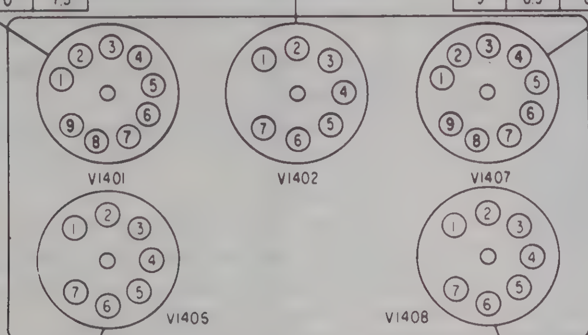
TUBE PIN	VOLTAGE DC	VOLTAGE AC	RES (OHMS)
1	47	10	280K
2	-0.5	0.7	10K
3	0	0	140
4	25.2	0	1.6
5	12.6	0	10.2
6	260	0.8	11K
7	26	4	95K
8	285	36	16K
9	192	0	7.5

V1402

TUBE PIN	VOLTAGE DC	VOLTAGE AC	RES (OHMS)
1	10	10	50K
2	9	5.5	500K
3	6.3	0	1.9
4	0	0	0
5	9	48	50K
6	008	0.5	INF.
7	9	55	500K

V1407

MODE	AME/CW		SSB/FSK		RES (OHMS)
TUBE PIN	VOLTAGE DC	VOLTAGE AC	VOLTAGE DC	VOLTAGE AC	
1	185	2.2	210	35	32K
2	0	0.1	0	0.14	180
3	1.82	0.1	2	0.12	1K
4	126	0	12.6	0	82
5	0	0	0	0	0
6	152	07	245	07	31K
7	142	22	19	0.22	800K
8	148	022	47	015	24K
9	6.3	0	63	0	60



NOTES

1. AC AND DC READINGS MADE WITH VTVM
2. RESISTANCE MEASUREMENTS MADE WITH 20,000-OHM-PER-VOLT METER
3. EQUIPMENT TUNED TO 2.0 MC (BKBB)
4. ALL MEASUREMENTS MADE WITH RESPECT TO GROUND.
5. EQUIPMENT MUST BE IN TUNE MODE AND KEYED TO MAKE MEASUREMENTS
6. OPERATION OF BALANCED MODULATOR IS ABNORMAL WITH TUBE ADAPTER IN SOCKET

V1406

MODE	AME/CW		SSB/FSK		RES (OHMS)
TUBE PIN	VOLTAGE DC	VOLTAGE AC	VOLTAGE DC	VOLTAGE AC	
1	0.2	0.67	0.2	1.6	INF
2	-026	1.1	-0.27	20	INF
3	25.2	0	252	0	1.6
4	192	0	192	0	52
5	0	14	0	18	23K
6	-03*	0	-03*	0	INF.
7	0	1.4	0	1.8	2.3K

* MAY HAVE READING DUE TO HIGH VOLTAGE FROM PA TANK NORMAL READING IS ZERO

V1408

MODE	AME/CW		SSB/FSK		RES (OHMS)
TUBE PIN	VOLTAGE DC	VOLTAGE AC	VOLTAGE DC	VOLTAGE AC	
1	-56	022	-64	041	58K
2	03	025	03	025	180
3	189	0	189	0	65
4	126	0	126	0	42
5	245	22	250	25	11K
6	230	0	240	0	53K
7	0.3	0.25	0.3	025	180

Figure 7-88. Modulator Subassembly Tube Voltage and Resistance Diagram

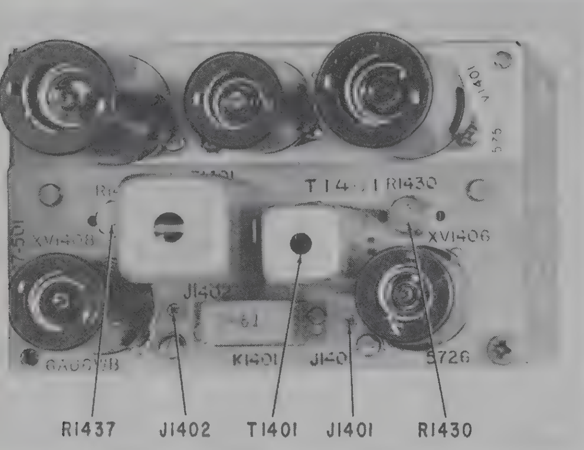


Figure 7–89. Modulator Subassembly Test and Alinement Points

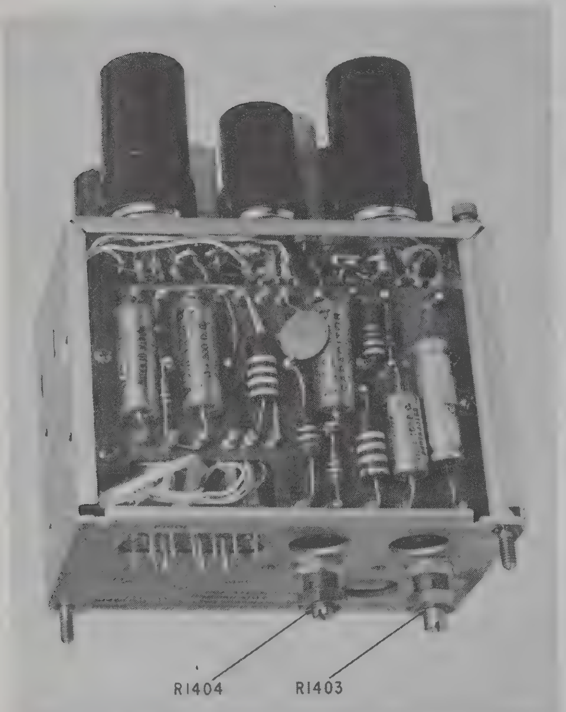


Figure 7–90. Modulator Subassembly, Level Adjustment Location

7–184. REMOVAL AND REPLACEMENT. The modulator subassembly can be removed from the main chassis and disassembled as follows:

a. Loosen the two redheaded screws.

b. Pull the subassembly straight up and out of the chassis receptacle.

c. Remove the shield cover by removing the two screws at the top covers of the subassembly and sliding the cover from the unit.

d. Access to the detail parts mounted on the terminal boards can be attained by removing the Phillips-head screws securing TB1401 and TB1402 in place and carefully laying the terminal board assembly to one side of the unit. Use care in this procedure in order to prevent damage to the interconnecting wiring.

e. Reassembly and replacement of the subassembly on the main chassis can be accomplished by reversing these procedures.

7–185. ALINEMENT AND ADJUSTMENT. The gain, clipping, and balance controls of the modulator subassembly are to be adjusted with the subassembly in place on the main chassis. The balance control is accessible from the top of the chassis and the gain and clipping controls must be adjusted from the bottom of the main chassis. All adjustments must be made with the receiver-transmitter connected in the bench test setup shown in figure 2–2. Alinement of transformer T1401 should not be attempted unless the transformer has been replaced. This can be accomplished as follows:

a. Connect the probe of the vtvm to pin 1 of J309 (test point J, figure 7–3, located on the underside of the main chassis).

b. Set the function switch on the radio set control to the "SSB/FSK" position.

c. Set the "CHANNEL" select switches on the radio set control to "TCZZ."

d. Rotate the tuning slug in the top of T1401 for a maximum voltage reading. A normal reading will be between 5 and 8 volts rms.

7–186. Adjust the gain, clipping, and balance controls as follows:

a. Connect the outputs of the two audio oscillators (TS–382/U) to the "MIC" input through the dummy microphone.

b. Set one oscillator to an output frequency of 1000 cps and the second to 1700 cps. Adjust the output level of each oscillator to 0.23 volt rms as measured across the microphone jack.

c. Connect the dummy load to the T-adapter.

d. Connect the oscilloscope to the T-adapter.

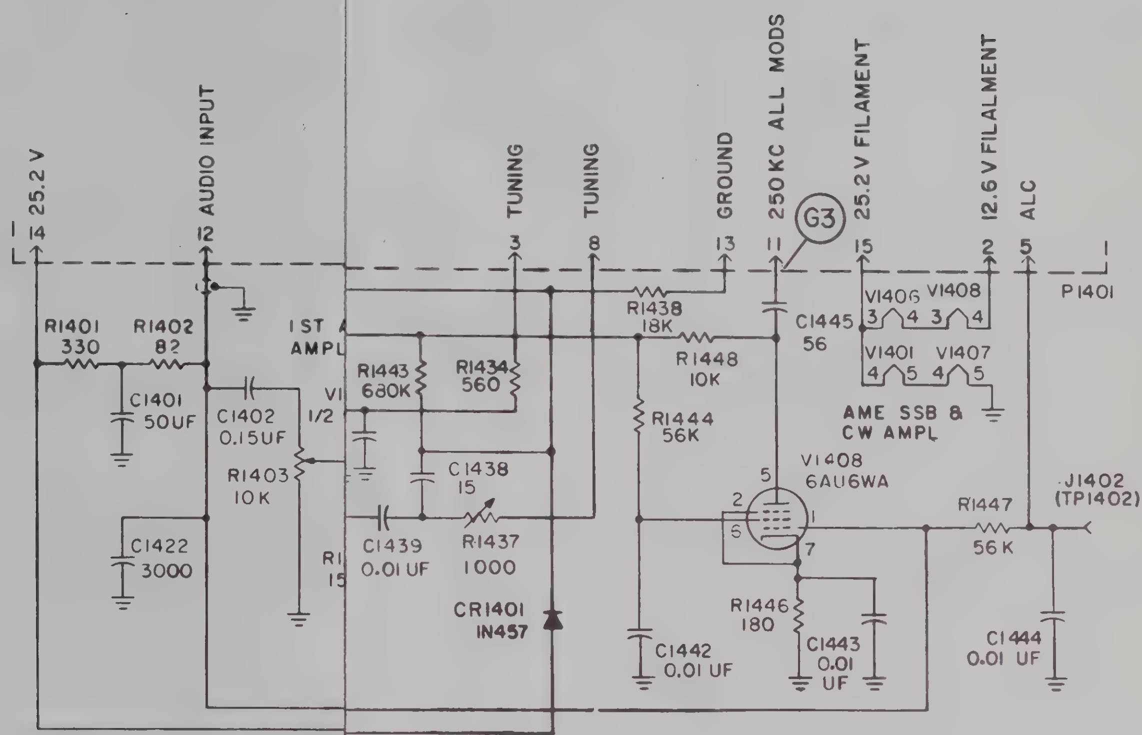
e. Deleted.

f. Apply power to all equipment and allow sufficient time (ten minutes minimum) for warmup.

g. Operate the clipping control ("R1404") to the maximum clockwise rotation.

h. Connect the vtvm to "J1402" and key transmitter. A 100-percent modulated waveform should be observed on the oscilloscope and a reading of —2 to —3 volts should be noted on the vtvm.

i. If not, readjust the gain control ("R1403") until a reading of at least —2 volts is obtained.



lulator Subassembly, Schematic Diagram

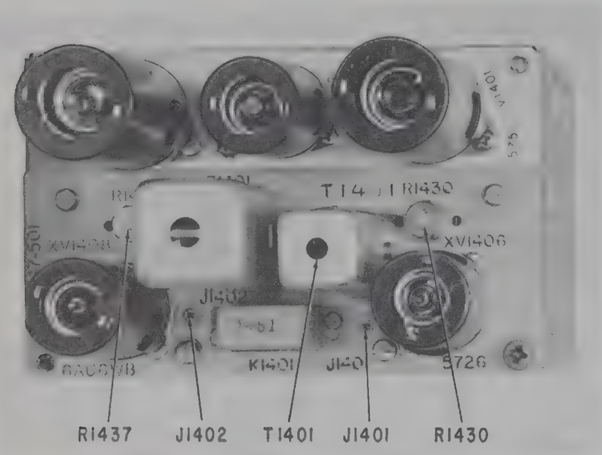


Figure 7–89. Modulator Subassembly Test and Alinement Points

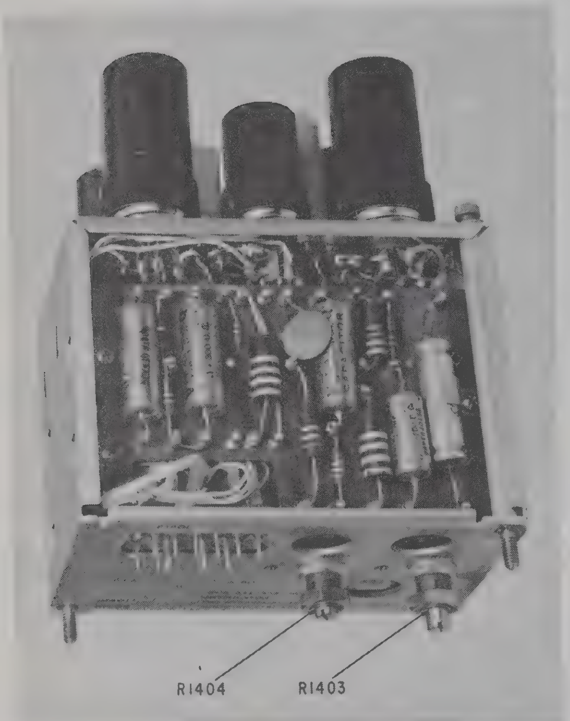


Figure 7–90. Modulator Subassembly, Level Adjustment Location

7–184. REMOVAL AND REPLACEMENT. The modulator subassembly can be removed from the main chassis and disassembled as follows:

a. Loosen the two redheaded screws.

b. Pull the subassembly straight up and out of the chassis receptacle.

c. Remove the shield cover by removing the two screws at the top covers of the subassembly and sliding the cover from the unit.

d. Access to the detail parts mounted on the terminal boards can be attained by removing the Phillips-head screws securing TB1401 and TB1402 in place and carefully laying the terminal board assembly to one side of the unit. Use care in this procedure in order to prevent damage to the interconnecting wiring.

e. Reassembly and replacement of the subassembly on the main chassis can be accomplished by reversing these procedures.

7–185. ALINEMENT AND ADJUSTMENT. The gain, clipping, and balance controls of the modulator subassembly are to be adjusted with the subassembly in place on the main chassis. The balance control is accessible from the top of the chassis and the gain and clipping controls must be adjusted from the bottom of the main chassis. All adjustments must be made with the receiver-transmitter connected in the bench test setup shown in figure 2–2. Alinement of transformer T1401 should not be attempted unless the transformer has been replaced. This can be accomplished as follows:

a. Connect the probe of the vtvm to pin 1 of J309 (test point J, figure 7–3, located on the underside of the main chassis).

b. Set the function switch on the radio set control to the "SSB/FSK" position.

c. Set the "CHANNEL" select switches on the radio set control to "TCZZ."

d. Rotate the tuning slug in the top of T1401 for a maximum voltage reading. A normal reading will be between 5 and 8 volts rms.

7–186. Adjust the gain, clipping, and balance controls as follows:

a. Connect the outputs of the two audio oscillators (TS–382/U) to the "MIC" input through the dummy microphone.

b. Set one oscillator to an output frequency of 1000 cps and the second to 1700 cps. Adjust the output level of each oscillator to 0.23 volt rms as measured across the microphone jack.

c. Connect the dummy load to the T-adapter.

d. Connect the oscilloscope to the T-adapter.

e. Deleted.

f. Apply power to all equipment and allow sufficient time (ten minutes minimum) for warmup.

g. Operate the clipping control ("R1404") to the maximum clockwise rotation.

h. Connect the vtvm to "J1402" and key transmitter. A 100-percent modulated waveform should be observed on the oscilloscope and a reading of —2 to —3 volts should be noted on the vtvm.

i. If not, readjust the gain control ("R1403") until a reading of at least —2 volts is obtained.

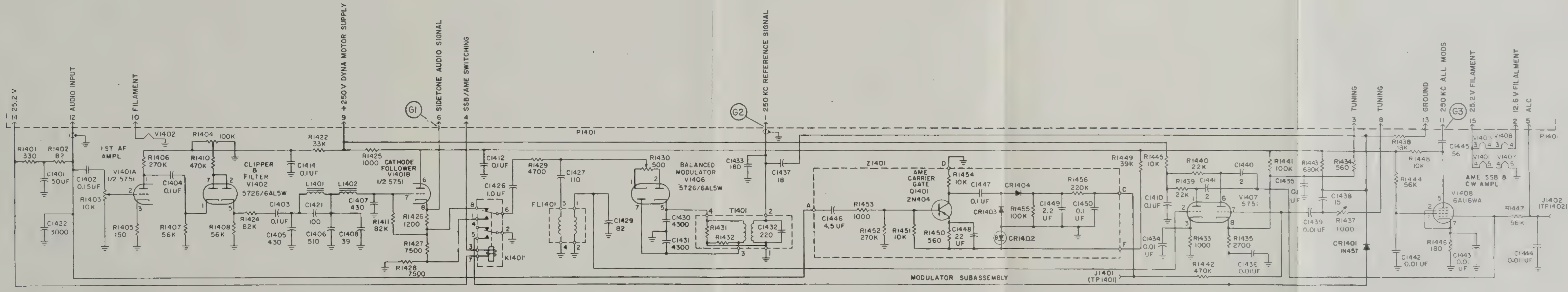


Figure 7–91. Modulator Subassembly, Schematic Diagram

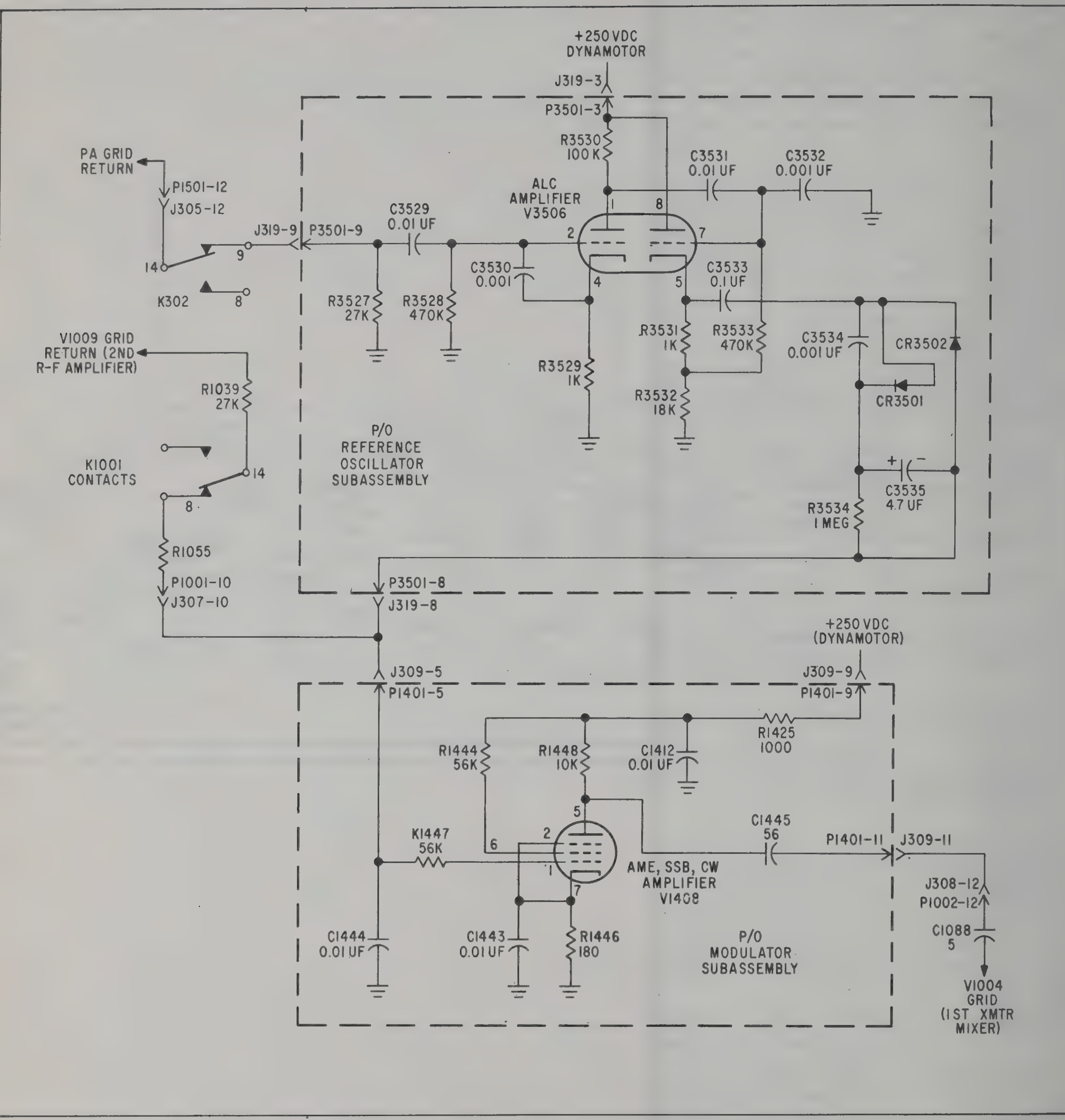


Figure 7–94. Automatic Level Control (ALC) Circuits, Simplified Schematic Diagram

Note

The voltage measured at "J1402" will vary between −1 and −6 volts for r-f frequencies other than 14.2495 mc.

j. Readjust the clipping control ("R1404") counterclockwise until the alc voltage measured at "J1402" just starts to decrease. The point at which the clipping action starts can also be observed on the oscilloscope.

k. Remove both audio signals from the microphone jack and ground the microphone input.

l. Connect the vtvm to the dummy load.

m. Key the transmitter and note the residual r-f voltage measured by the vtvm. This should be no greater than 0.7 volt rms. If higher than 0.7 volt rms, adjust the balance control ("R1430") for a minimum reading. If trouble is experienced from ripple in the 27.5-volt line coupling into the input circuit, temporarily reduce the gain control to zero while making this adjustment.

n. After proper adjustment of the carrier balance control, reset the gain and clipping controls as described in steps h through j. When all controls are properly adjusted a 100-percent modulated waveform relatively free of peak clipping should be observed on the oscilloscope and a minimum reading of 50 volts rms should be observed on the vtvm. These measurements can be made by repeating steps a through f and keying the transmitter.

7-187. Adjust the ame carrier control as follows:

a. Connect the output of an audio oscillator to the "MIC" input jack through the dummy load.

b. Set the oscillator ot a frequency output of 1000 cps at a level of 0.46 volt rms as measured across the microphone jack.

c. Set the function switch on the radio set control to the "AME" position.

d. Key the transmitter and observe the output waveshape on the oscilloscope and the voltage measured by the vtvm. The waveform on the oscilloscope should show a normal 100-percent modulated pattern relatively free of peak clipping. The r-f voltage across the dummy load should be a minimum of 50 volts rms.

e. If a 100-percent modulated waveform is not obtained, adjust the carrier control ("R1437") for correct output. This adjustment must always be checked after the gain and clipping controls have been adjusted.

7-188. DETAILED CIRCUIT ANALYSIS. The circuit analysis of the modulator subassembly is divided into three parts in the following paragraphs. These parts are: (1) the audio amplifier and clipping circuits; (2) the balanced modulator and carrier insert circuits; and (3) the alc circuits. In order to facilitate the explanation, simplified schematic diagrams are provided for the three circuits showing the terminations and circuits on other subassemblies. These diagrams should be referenced where noted and used in conjunction with the overall subassembly diagrams while studying the following theory of operation.

7-189. Audio Amplifiers and Clipper. Microphone exciting current is obtained from the 27.5-volt d-c line through dropping resistor R1401 and load resistor R1402 as shown in figure 7-92. Capacitor C1401 acts as a filter to prevent hum and noise on the d-c line from causing interference in the microphone circuit. The audio signal is coupled through capacitor C1402 and developed across potentiometer R1403. The potentiometer is located on the bottom of the modulator subassembly and is a screwdriver setup adjustment used to set the microphone level. The signal is amplified by V1401A and coupled through capacitor C1404 to the cathode (pin 1) of the clipper stage, V1402.

7-190. The clipper stage, V1402, is a dual diode tube connected as a biased series clipper circuit. The clipping level can be adjusted by R1404, which is connected across the 250-volt d-c line. Assume for purposes of explanation, that R1404 is set to the correct position for a level of plus 10 volts dc at the plates of V1402. Under static conditions, the voltage at both cathodes will be plus 10 volts dc, and will remain so as long as both diode sections conduct. While the diodes are conducting, the plate resistance may be assumed to be zero, resulting in equal voltages at both the plates and cathodes of the diodes. When an alternating signal is applied across R1407, this signal will both add and subtract from the plus 10 volts dc present at the input cathode. Assume the alternating signal has a peak-to-peak value of 10 volts. On the positive alternation, as the signal voltage rises from zero to plus 5 volts, the input cathode voltage will rise from the fixed 10 volts to a total of 15 volts. Since a short-circuit condition exists between the input cathode and its plate during conduction, this signal will also appear at the plate (pin 7) and will drive both plates to plus 15 volts. A short-circuit also exists between the plate (pin 2) and the output cathode, which drives the output cathode, and therefore the output signal, to plus 15 volts. As the input alternating signal rises to its peak negative value, the negative 5 volts will subtract from the 10 volts present at the input cathode, driving the voltage to plus 5 volts. The short-circuit conditions still exist between all of the tube elements, and the voltage at the output cathode will follow the change to plus 5 volts. From this it can be seen that as long as the input voltage does not exceed the ten volts to which the tube is biased, the output signal will follow faithfully the input signal, and the clipper stage acts merely as a conductor. Clipping action will start as soon as the input voltage exceeds the plus 10-volt bias, or as soon as the input voltage exceeds a peak-to-peak value of 20 volts. Assume that a strong noise pulse with a peak-to-peak value of 30 volts is coupled through capacitor C1404 and applied to the input cathode. On the positive alternation (0 to 15 volts), the input cathode will follow the changing voltage,

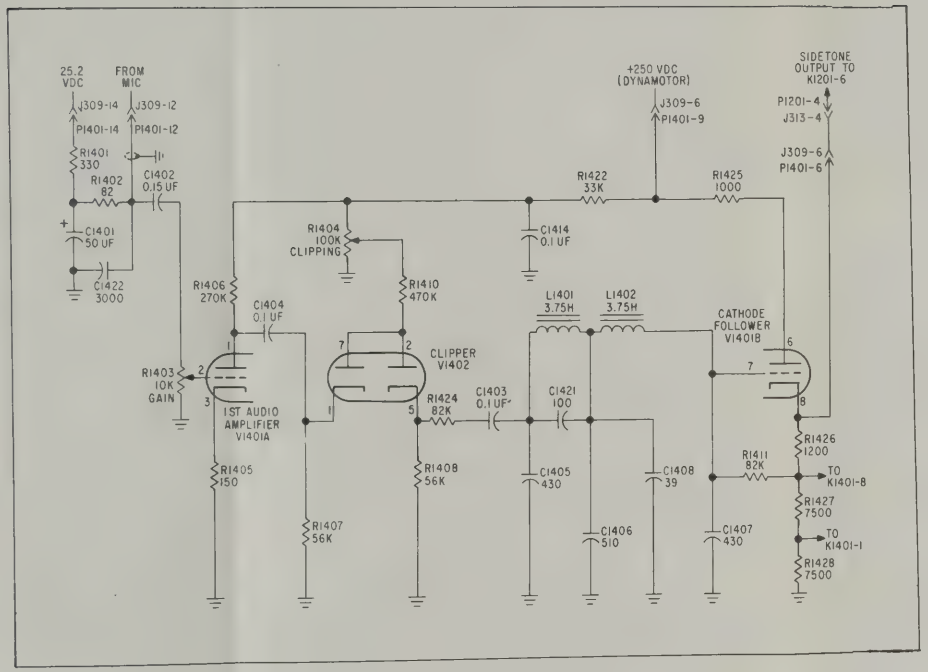


Figure 7–92. Audio Amplifier and Clipper Circuits, Simplified Schematic Diagram

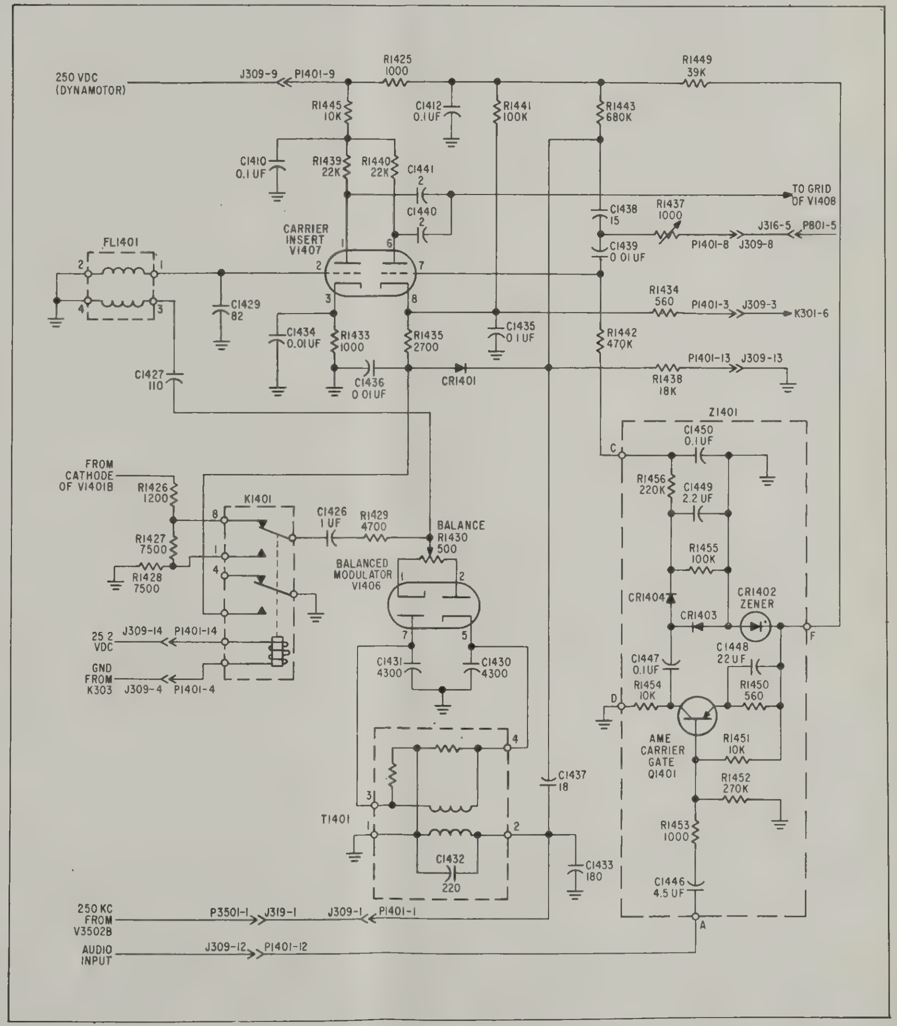


Figure 7–93. Balanced Modulator and Carrier Insert Circuits, Simplified Schematic Diagram

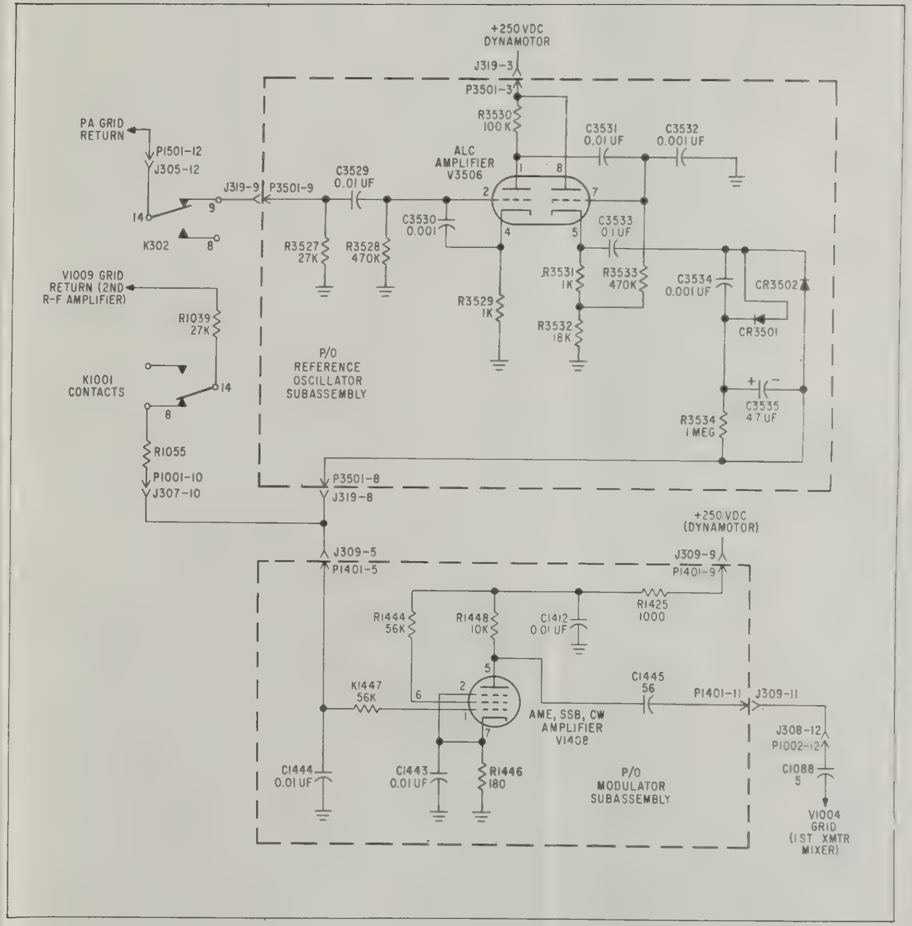


Figure 7–94. Automatic Level Control (ALC) Circuits, Simplified Schematic Diagram

Note

The voltage measured at "J1402" will vary between −1 and −6 volts for r-f frequencies other than 14.2495 mc.

j. Readjust the clipping control ("R1404") counterclockwise until the alc voltage measured at "J1402" just starts to decrease. The point at which the clipping action starts can also be observed on the oscilloscope.

k. Remove both audio signals from the microphone jack and ground the microphone input.

l. Connect the vtvm to the dummy load.

m. Key the transmitter and note the residual r-f voltage measured by the vtvm. This should be no greater than 0.7 volt rms. If higher than 0.7 volt rms, adjust the balance control ("R1430") for a minimum reading. If trouble is experienced from ripple in the 27.5-volt line coupling into the input circuit, temporarily reduce the gain control to zero while making this adjustment.

n. After proper adjustment of the carrier balance control, reset the gain and clipping controls as described in steps h through j. When all controls are properly adjusted a 100-percent modulated waveform relatively free of peak clipping should be observed on the oscilloscope and a minimum reading of 50 volts rms should be observed on the vtvm. These measurements can be made by repeating steps a through f and keying the transmitter.

7-187. Adjust the ame carrier control as follows:

a. Connect the output of an audio oscillator to the "MIC" input jack through the dummy load.

b. Set the oscillator ot a frequency output of 1000 cps at a level of 0.46 volt rms as measured across the microphone jack.

c. Set the function switch on the radio set control to the "AME" position.

d. Key the transmitter and observe the output waveshape on the oscilloscope and the voltage measured by the vtvm. The waveform on the oscilloscope should show a normal 100-percent modulated pattern relatively free of peak clipping. The r-f voltage across the dummy load should be a minimum of 50 volts rms.

e. If a 100-percent modulated waveform is not obtained, adjust the carrier control ("R1437") for correct output. This adjustment must always be checked after the gain and clipping controls have been adjusted.

7-188. DETAILED CIRCUIT ANALYSIS. The circuit analysis of the modulator subassembly is divided into three parts in the following paragraphs. These parts are: (1) the audio amplifier and clipping circuits; (2) the balanced modulator and carrier insert circuits; and (3) the alc circuits. In order to facilitate the explanation, simplified schematic diagrams are provided for the three circuits showing the terminations and circuits on other subassemblies. These diagrams should be referenced where noted and used in conjunction with the overall subassembly diagrams while studying the following theory of operation.

7-189. Audio Amplifiers and Clipper. Microphone exciting current is obtained from the 27.5-volt d-c line through dropping resistor R1401 and load resistor R1402 as shown in figure 7-92. Capacitor C1401 acts as a filter to prevent hum and noise on the d-c line from causing interference in the microphone circuit. The audio signal is coupled through capacitor C1402 and developed across potentiometer R1403. The potentiometer is located on the bottom of the modulator subassembly and is a screwdriver setup adjustment used to set the microphone level. The signal is amplified by V1401A and coupled through capacitor C1404 to the cathode (pin 1) of the clipper stage, V1402.

7-190. The clipper stage, V1402, is a dual diode tube connected as a biased series clipper circuit. The clipping level can be adjusted by R1404, which is connected across the 250-volt d-c line. Assume for purposes of explanation, that R1404 is set to the correct position for a level of plus 10 volts dc at the plates of V1402. Under static conditions, the voltage at both cathodes will be plus 10 volts dc, and will remain so as long as both diode sections conduct. While the diodes are conducting, the plate resistance may be assumed to be zero, resulting in equal voltages at both the plates and cathodes of the diodes. When an alternating signal is applied across R1407, this signal will both add and subtract from the plus 10 volts dc present at the input cathode. Assume the alternating signal has a peak-to-peak value of 10 volts. On the positive alternation, as the signal voltage rises from zero to plus 5 volts, the input cathode voltage will rise from the fixed 10 volts to a total of 15 volts. Since a short-circuit condition exists between the input cathode and its plate during conduction, this signal will also appear at the plate (pin 7) and will drive both plates to plus 15 volts. A short-circuit also exists between the plate (pin 2) and the output cathode, which drives the output cathode, and therefore the output signal, to plus 15 volts. As the input alternating signal rises to its peak negative value, the negative 5 volts will subtract from the 10 volts present at the input cathode, driving the voltage to plus 5 volts. The short-circuit conditions still exist between all of the tube elements, and the voltage at the output cathode will follow the change to plus 5 volts. From this it can be seen that as long as the input voltage does not exceed the ten volts to which the tube is biased, the output signal will follow faithfully the input signal, and the clipper stage acts merely as a conductor. Clipping action will start as soon as the input voltage exceeds the plus 10-volt bias, or as soon as the input voltage exceeds a peak-to-peak value of 20 volts. Assume that a strong noise pulse with a peak-to-peak value of 30 volts is coupled through capacitor C1404 and applied to the input cathode. On the positive alternation (0 to 15 volts), the input cathode will follow the changing voltage,

and will become positive a total of 25 volts (10 volts bias plus 15 volts signal). The plates are biased to plus 10 volts, resulting in the input cathode becoming 5 volts more positive than the plates. As the input cathode must be slightly negative with respect to its plate for conduction, the input diode section will become open circuited. As long as the input signal was below plus 10 volts, the plate (pin 7) was able to follow the input cathode, and was driven to plus 20 volts (10 volts bias added to the 10 volts of signal). The plates (pins 7 and 2) cannot rise above the plus 20 volts, and will remain at this point until the input cathode voltage decreases to a value no greater than 20 volts. The output cathode continues to conduct, resulting in an output voltage of plus 20 volts even though the input cathode has risen to a total of plus 25 volts. On the negative alternation of the noise pulse, the input cathode is driven to negative 5 volts (plus 10 volts bias, minus 15 volts signal). The plate (pin 7) will follow this change to negative 5 volts, and will continue to conduct because at no time is the cathode positive with respect to the plate (pin 7). The plate (pin 2) also must become negative a total of 5 volts as it is paralleled with the pin 7 plate. The output cathode will decrease to as far as zero voltage, at which point its plate (pin 2) becomes negative, and the output diode circuit must cutoff. In this manner, with double clipping action taking place, the output signal will follow the input signal only to the extent of a peak input of 10 volts (20 volts, peak-to-peak), and any strong signal such as a noise pulse or loud speech will be effectively eliminated.

7–191. The audio signal from the output cathode of V1402 is fed through resistor R1424 and capacitor C1403 to the low-pass filter network consisting of L1401, L1402, C1405, C1406, C1407, C1408, and C1421. Resistor R1424 performs the function of isolating the filter from the changing impedance of the clipper stage. The low-pass filter is designed for a cutoff frequency of 3500 cps at which point the maximum attenuation will not exceed 3 db. The minimum attenuation at 6500 cps is at least 17 db. Thus, all harmonic frequencies introduced in the clipper stage are removed. The audio signal from the filter is developed across grid resistor R1411, and appears across the resistance network in the cathode circuit of the cathode follower, V1401B. The resistance network on the cathode circuit of V1401B consists of R1426, R1427, and R1428. The audio signal at the cathode (pin 8) is connected through contacts on relay K1201 located in the sidetone gate circuit (to be described in paragraph 7–244) to the input of the audio amplifier subassembly for reproduction in the headset, or intercom. The audio signal appearing at the junction of R1426 and R1427 is connected through a set of contacts on K1401 to the balanced modulator tube, V1406, and a winding on the upper sideband filter, FL401. This is the normal connection when operating in the single sideband mode. In the ame mode of operation, the audio signal must be reduced to one-half the ssb value in order to keep the peak r-f signal the same amplitude. This reduction is required because one-half the ame signal is composed of cw carrier. Therefore, when operating in the cw or ame modes, relay K1401 is energized, and the audio signal to V1406 is reduced, by connecting the input through the relay contacts to the junction of resistors R1427 and R1428. Relay K1401 is actuated when choosing the mode of operation at the radio set control.

7–192. Balanced Modulator and Carrier Insert Circuits. Two signals are coupled into the balanced modulator as shown in figure 7–93. One is the audio signal from the cathode of V1401B, and the other a 250-kc signal derived from the locked oscillator located in the reference oscillator subassembly described in paragraph 7–112. The 250-kc signal is coupled to the balanced modulator through transformer T1401 and appears at the plate (pin 7) and cathode (pin 5) of V1406 with equal amplitude and opposite phase. During those half-cycles when one-half the tube is conducting in a positive direction and the other half is going negative, current will flow through the balance potentiometer R1430. When R1430 is set for proper balance, the circuit acts as a balanced bridge with the opposite polarity voltages at each end of the potentiometer varying equally and simultaneously, resulting in zero voltage at the point of contact of the movable arm. Audio modulating signals from the input are applied to the movable arm and the conduction level through the tube is varied at the audio rate. Mixing takes place in the tube and components of audio, the lower sideband of 250 kc, the 250-kc carrier, and the upper sideband of 250 kc are all present. The 250-kc signal will not appear at the output (same point as audio input) of the balanced modulator since it will always be cancelled as described previously. Both the upper and lower modulated sideband components are present at the output. Capacitor C1427 couples both sidebands to the upper sideband filter FL1401 and the filter suppresses the lower sideband and passes the upper sideband components to the amplifier stage, V1407.

7–193. As only the upper sideband components are required for operation in the ssb mode, the lower sideband components are eliminated by means of filter FL1401. This filter is of the mechanical type and has a center frequency of 251.8 kc with a pass band of +1.4 to −1.45 kc. As the lower cutoff frequency of the filter is 250.35 kc, approximately 20 db of additional attenuation is provided at the 250-kc carrier frequency. Totalling the attenuation of the sideband filter and balanced modulator, the carrier frequency is approximately 55 db below the level of the upper sideband and the unwanted lower sideband is 75 db below the same reference level. The modulated upper sideband output of FL1401 is amplified by the ssb amplifier V1407A and the ame, ssb, and cw amplifier, V1408.

7–194. When operating in the cw and ame modes, it is necessary to provide a means of transmission which can be received on a conventional am receiver. This is accomplished by combining the 250-kc carrier signal with the single sideband in the proper ratio when operating in the ame mode. The mixing of these two signals takes place in the grid circuit of V1408. Reduction of the amplitude of the single sideband signal is accomplished by operation of K1401 (as described in paragraph 7–191) which connects one-half of the audio signal to the balanced modulator input. Simultaneously, a second set of contacts on K1401 operates to ground the cathode circuit of the ame carrier insert tube, V1407B, and the anode of the diode, CR1401. Grounding of the cathode of V1407B causes the tube to conduct and grounding of the anode causes the diode to cease conducting permitting the 250-kc carrier to pass through the tube. Reduction of the carrier signal is accomplished by self-biasing V1407B to cutoff so only a very small amount of carrier signal will be passed to V1408. Bias for the stage is obtained by connecting the cathode to a positive potential provided by the resistor network comprising R1435 and R1441. When modulation is present, the ame carrier gate (Q1401) circuit produces a positive bias voltage which is applied to the grid of V1407B through R1442. This increases the conduction through V1407B sufficiently to supply the required carrier level for ame operation. Potentiometer R1437, connected between the grid circuit of V1407B and terminal 8 of P1401 is used to establish the proper carrier level for ame operation. When operating in the ame mode, R1437 is returned to ground through contacts on K803 (on the relay subassembly) and K301 (on the main chassis).

7–195. When operating in the cw mode or when tuning the transmitter, the ground is removed from R1437 and the bias is reduced on V1407B to increase the carrier level. This is accomplished by connecting resistor R1434 to ground through the contacts of K803 and K301.

7–196. The ame carrier insert circuit (V1407B) must also be capable of complete cutoff when operating in the ssb mode, or the 250-kc signal will leak through and degrade the ssb transmission. Therefore, the contacts of relay K1401 operate to remove the ground from the cathode of V1407B and the anode of CR1401. This action prevents V1407B from conducting and causes the diode to conduct. With the diode conducting the grid of V1407B is effectively grounded.

7–197. The output of V1408 is applied to the first transmitter mixer, V1004, where it is combined with the output of the buffer amplifier, V3308. Further amplification and frequency multiplication is then accomplished as described previously.

7–198. Automatic Level Control (ALC). As the output level of V1408 will vary with operating frequency, the level must be held constant. This is accomplished by controlling the bias applied to the control grid of V1408. The required bias voltage is developed in the automatic level-control stage consisting of V3506, CR3501, CR3502, and associated components shown in figure 7–94. From the figure it will be noted that the input to V3506 is connected in series with the grid return of the power amplifier stage. Any change in the level of the driving voltage to the power amplifier grids will be coupled to the grid of V3506 through capacitor C3529. The amplified output of the first half of the tube is coupled to the grid of the cathode follower output through capacitor C3531. The resultant output voltage at the cathode is converted to dc by means of the voltage-doubler rectifier circuit comprising diodes CR3501 and CR3502, capacitors C3533, C3534, and C3535, and load resistor, R3534. The d-c bias voltage is then connected to the grid of V1408 for control of amplification of the stage. Resistor R1447 and capacitor C1444 are used to attenuate any spurious noise peaks that may occur on the interconnecting wires between the respective subassemblies.

7–199. RELAY SUBASSEMBLY.

7–200. GENERAL DATA. When isolating trouble within the relay subassembly, the complete system must be considered. Each of the four relays within the relay subassembly perform several functions which affect the system operation. Paragraphs 7–205 through 7–208 outline the functions of each relay. By observing the faults encountered within the tuning, mode selection, and keying circuits, and by study of the relay functions presented in paragraphs 7–205 through 7–208, the relay or circuit at fault can be analyzed. It must be remembered that the relay subassembly operates in conjunction with the circuits contained in the front panel, tuner, and power amplifier subassemblies, and the relays mounted on the main chassis. In addition to the four relays, the relay subassembly contains the voltage regulator circuit which supplies the regulated +150 volts dc to the equipment. As no lubrication or alinement adjustments are required by this subassembly, these paragraphs have been omitted.

7–201. MINIMUM PERFORMANCE STANDARDS. The relay subassembly is to be removed from the main chassis and the relays tested for correct operation using an ohmmeter, and a source of 27.5 volts dc. Reference should be made to the schematic diagram (figure 7–95) and continuity measured between the closed contacts of the individual relays at the respective terminals of P801 and P802. This test should be performed with the 27.5-volt d-c source disconnected. Proceed as follows to check the subassembly with the 27.5-volt d-c source connected:

a. Connect the 27.5-volt d-c source between pins 12(+) and 12(−) of P801 and P802, respectively. Relay K802 should be energized.

b. Approximately 2.6 volts dc should be measured between pins 2 of P802 and 5 of P801 and between pins 15 of P802 and 5 of P801.

c. Connecting the ohmmeter between pins 1 and 5 of P801 should result in a zero reading.

d. Connect a jumper between pins 7 and 12 of P801, leaving the d-c source connected as in step a. Relays K801 and K802 should be energized.

e. Zero ohms should be measured between pins 9 of P802 and 5 of P801, and between 2 and 5 of P801.

f. Disconnect the jumper from between pins 7 and 12 of P801 and connect the d-c source between pins 7 and 10 of P801. Relays K801 and K802 should be deenergized and K803 should be energized.

g. Zero ohms should be measured between pins 1 and 4 of P802, 1 of P802 and 5 of P801, and 47,000 ohms between pins 11 of P802 and 5 of P801.

h. Connect the d-c source to pins 3 and 7 of P802. Relay K803 should be deenergized and K804 should be energized.

i. Zero ohms should be measured between pins 11 and 5, 13 and 6, and 4 and 9 of P801.

j. Disconnect all test equipment and connect the subassembly to the main chassis by means of an extension cable.

k. Set the function switch on the radio set control to the "AME" position and allow all equipment to warmup for a minimum of ten minutes.

l. Connect the probes of the vtvm between pin 14 (+) and ground. A reading of +150 volt dcs, ±5.0 volts, should be obtained.

7–202. CHECK-OUT OR ANALYSIS. As the relay subassembly contains a minimum of parts, no trouble analysis chart is supplied. A malfunction in this subassembly can be isolated by performing the procedures of paragraph 7–201. When the faulty relay or other detail part has been located, the fault should be corrected either by replacement or repair. Field maintenance personnel should not attempt to burnish relay contacts or perform major overhauls on any of the relays. If a relay is defective, the entire relay should be replaced. Figure 7–95 shows the input and output voltages that should be present for a normally operating voltage regulator stage. This figure should be referenced when trouble is experienced in the +150 volt d-c circuit.

7–203. REMOVAL AND REPLACEMENT. The relay subassembly can be removed by loosening the two redheaded screws and lifting the unit straight up and out of the main chassis. Access to the components can be attained by removing the two corner screws and sliding the shield cover off the top of the unit.

7–204. DETAILED CIRCUIT ANALYSIS. The functions of the four relays contained in the relay subassembly are described in paragraphs 7–205 through 7–208. Regulated +150 volts dc is provided by means of tube V801, capacitor C801, and resistor R801. The 250-volt output of the rectifier power supply (located in Power Supply 416W–1) is connected through pin 13 of P802 and the current limiting resistor to the anode of the gaseous type regulator tube V801. As the cathode of V801 is connected to ground, the tube will operate to minimize any voltage variations in the 150 volts connected through pin 14 of P802 to the equipment. Capacitor C801 is needed to suppress any high frequency transients that may appear in the 150-volt circuits.

7–205. Relay K801. Steps a through d describe the functions of sequence relay K801. This relay is energized during the channeling cycle. Contacts on K801 perform the following functions after being energized:

a. Provide a ground pulse to energize Automatic Antenna Tuner 180L–3.

b. Open the keying circuit between the "MIC" and "KEY" jacks and keying relays K804, K1001, and K1501.

c. Open the dynamotor start circuit, preventing dynamotor D1601 from operating during the channeling cycle.

d. Provide a ground to relay K1502 to energize the power amplifier centering circuit.

7–206. Relay K802. Steps a through c describe the functions of the tuner centering relay, K802. This relay is energized during the channeling cycle through contacts on K3301. Contacts of relay K802 perform the following functions after being energized.

a. Provide a self-locking ground during the tuner centering cycle.

b. Connect the tuner table centering circuit to the tuner servo amplifier subassembly, driving servomotor B102.

c. Provide a holding ground for relay K801 during the tuner centering cycle.

7–207. Relay K803. Steps a through d describe the functions of the phone-cw relay, K803. This relay is energized through contacts on the function switch (located in the radio set control) when set to the "CW" position. Contacts of K803 perform the following functions after being energized.

a. Ground the avc voltage applied to the tuner subassembly through resistor R807, reducing the avc during cw reception.

b. Provide a ground circuit for the cathode of bfo tube V1202 through contacts of relay K804.

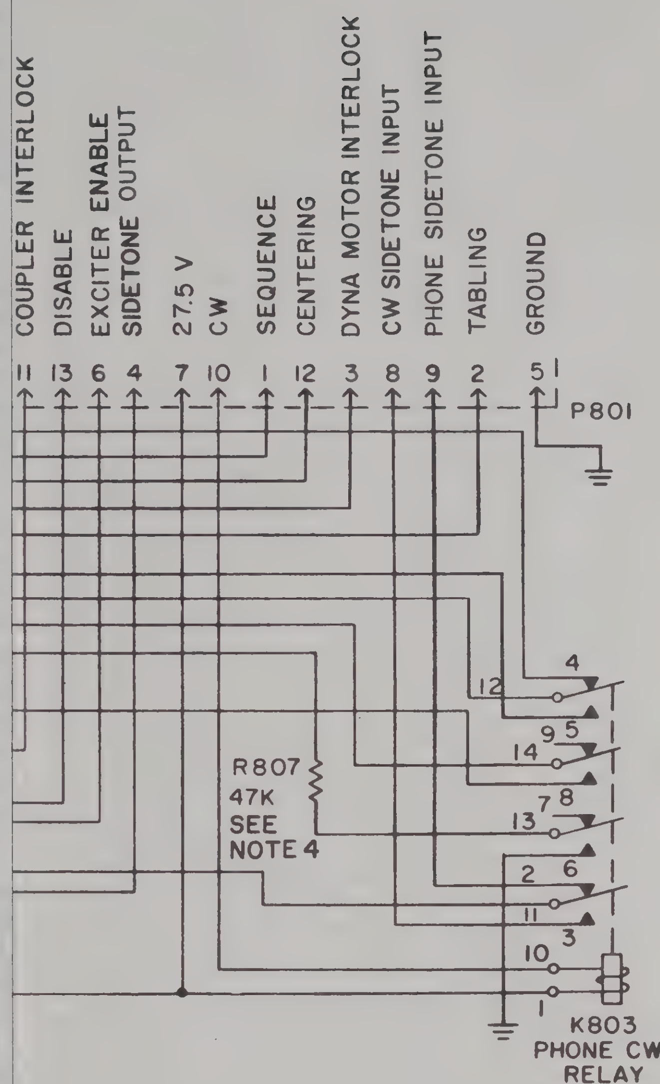
c. Remove the phone sidetone circuit and complete the cw sidetone circuit.

d. Provide ground through contacts of chassis mounted relay K303 to K1401 located in modulator subassembly.

7–208. Relay K804. Steps a through d describe the functions of keying relay K804. This relay is energized whenever the telegraph key or microphone push-to-talk button is operated. Contacts on K804 perform the following functions after the relay is energized.

a. Complete both the phone and cw sidetone circuits to the audio amplifier subassembly.

b. Provide ground to choppers within Automatic Antenna Tuner 180L–3.



. *Relay Subassembly, Schematic Diagram*

c. Connecting the ohmmeter between pins 1 and 5 of P801 should result in a zero reading.

d. Connect a jumper between pins 7 and 12 of P801, leaving the d-c source connected as in step a. Relays K801 and K802 should be energized.

e. Zero ohms should be measured between pins 9 of P802 and 5 of P801, and between 2 and 5 of P801.

f. Disconnect the jumper from between pins 7 and 12 of P801 and connect the d-c source between pins 7 and 10 of P801. Relays K801 and K802 should be deenergized and K803 should be energized.

g. Zero ohms should be measured between pins 1 and 4 of P802, 1 of P802 and 5 of P801, and 47,000 ohms between pins 11 of P802 and 5 of P801.

h. Connect the d-c source to pins 3 and 7 of P802. Relay K803 should be deenergized and K804 should be energized.

i. Zero ohms should be measured between pins 11 and 5, 13 and 6, and 4 and 9 of P801.

j. Disconnect all test equipment and connect the subassembly to the main chassis by means of an extension cable.

k. Set the function switch on the radio set control to the "AME" position and allow all equipment to warmup for a minimum of ten minutes.

l. Connect the probes of the vtvm between pin 14 (+) and ground. A reading of +150 volt dcs, ±5.0 volts, should be obtained.

7–202. CHECK-OUT OR ANALYSIS. As the relay subassembly contains a minimum of parts, no trouble analysis chart is supplied. A malfunction in this subassembly can be isolated by performing the procedures of paragraph 7–201. When the faulty relay or other detail part has been located, the fault should be corrected either by replacement or repair. Field maintenance personnel should not attempt to burnish relay contacts or perform major overhauls on any of the relays. If a relay is defective, the entire relay should be replaced. Figure 7–95 shows the input and output voltages that should be present for a normally operating voltage regulator stage. This figure should be referenced when trouble is experienced in the +150 volt d-c circuit.

7–203. REMOVAL AND REPLACEMENT. The relay subassembly can be removed by loosening the two redheaded screws and lifting the unit straight up and out of the main chassis. Access to the components can be attained by removing the two corner screws and sliding the shield cover off the top of the unit.

7–204. DETAILED CIRCUIT ANALYSIS. The functions of the four relays contained in the relay subassembly are described in paragraphs 7–205 through 7–208. Regulated +150 volts dc is provided by means of tube V801, capacitor C801, and resistor R801. The 250-volt output of the rectifier power supply (located in Power Supply 416W–1) is connected through pin 13 of P802 and the current limiting resistor to the anode of the gaseous type regulator tube V801. As the cathode of V801 is connected to ground, the tube will operate to minimize any voltage variations in the 150 volts connected through pin 14 of P802 to the equipment. Capacitor C801 is needed to suppress any high frequency transients that may appear in the 150-volt circuits.

7–205. Relay K801. Steps a through d describe the functions of sequence relay K801. This relay is energized during the channeling cycle. Contacts on K801 perform the following functions after being energized:

a. Provide a ground pulse to energize Automatic Antenna Tuner 180L–3.

b. Open the keying circuit between the "MIC" and "KEY" jacks and keying relays K804, K1001, and K1501.

c. Open the dynamotor start circuit, preventing dynamotor D1601 from operating during the channeling cycle.

d. Provide a ground to relay K1502 to energize the power amplifier centering circuit.

7–206. Relay K802. Steps a through c describe the functions of the tuner centering relay, K802. This relay is energized during the channeling cycle through contacts on K3301. Contacts of relay K802 perform the following functions after being energized.

a. Provide a self-locking ground during the tuner centering cycle.

b. Connect the tuner table centering circuit to the tuner servo amplifier subassembly, driving servomotor B102.

c. Provide a holding ground for relay K801 during the tuner centering cycle.

7–207. Relay K803. Steps a through d describe the functions of the phone-cw relay, K803. This relay is energized through contacts on the function switch (located in the radio set control) when set to the "CW" position. Contacts of K803 perform the following functions after being energized.

a. Ground the avc voltage applied to the tuner subassembly through resistor R807, reducing the avc during cw reception.

b. Provide a ground circuit for the cathode of bfo tube V1202 through contacts of relay K804.

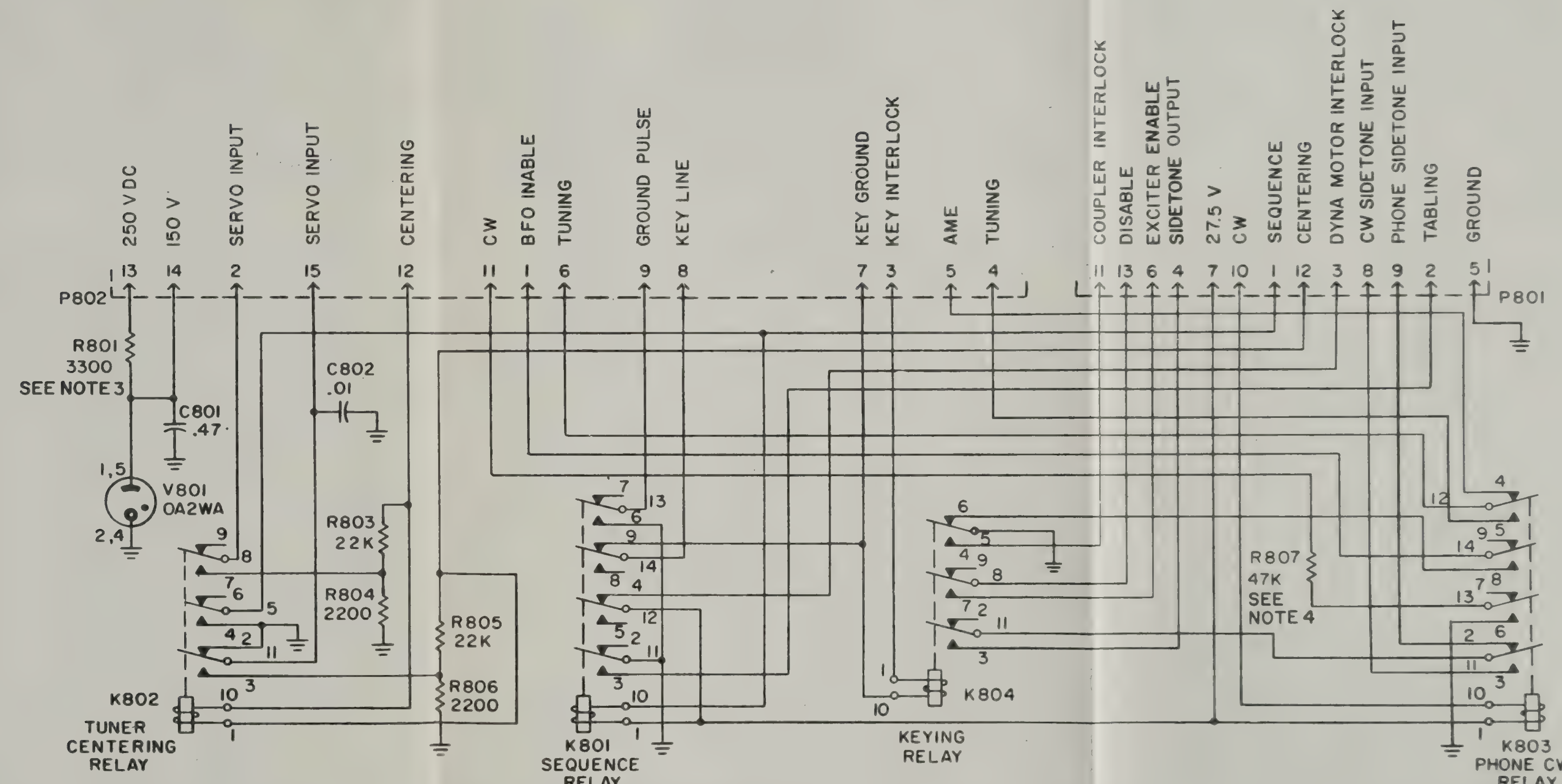
c. Remove the phone sidetone circuit and complete the cw sidetone circuit.

d. Provide ground through contacts of chassis mounted relay K303 to K1401 located in modulator subassembly.

7–208. Relay K804. Steps a through d describe the functions of keying relay K804. This relay is energized whenever the telegraph key or microphone push-to-talk button is operated. Contacts on K804 perform the following functions after the relay is energized.

a. Complete both the phone and cw sidetone circuits to the audio amplifier subassembly.

b. Provide ground to choppers within Automatic Antenna Tuner 180L–3.



NOTES:

1. ALL RESISTANCE VALUES ARE IN OHMS UNLESS OTHERWISE INDICATED.
2. ALL CAPACITORS ARE IN UF UNLESS OTHERWISE INDICATED.
3. POWER RATING OF R801 CHANGED FROM 5 WATTS TO 8 WATTS; MOD 3 OF RELAY SUBASSEMBLY.
4. RESISTOR R807 ADDED; MOD 2 OF RELAY SUBASSEMBLY.

Figure 7–95. Relay Subassembly, Schematic Diagram

c. Provide a ground circuit for tubes V1003, V1004, V1010, and V1011.

d. Open the cathode of bfo tube V1202 when keying the transmitter.

7–209. FRONT PANEL SUBASSEMBLY.

7–210. GENERAL DATA. The front panel subassembly is essentially comprised of a basic chassis with four major plug-in subassemblies and miscelleneous parts mounted on it. The four subassemblies are the bandchange autopositioner, the blower motor, servo motor, and the meter and associated selector switch. These subassemblies can be removed, replaced or repaired, adjusted, and lubricated as described in paragraphs 7–219 through 7–220.

7–211. MINIMUM PERFORMANCE STANDARDS. As the front panel subassembly is an integral part of the tuning control circuits of the receiver-transmitter, it is to be checked as outlined in paragraphs 7–43, 7–44, 7–117, and 7–162. Blower operation can be checked by listening to its operation and the meter can be checked by performing the tests outlined in steps b through g of paragraph 2–36.

7–212. CHECK-OUT OR ANALYSIS. When trouble in band changing is experienced, and the channelizer, tuner, and power amplifier subassemblies check out as normal, the faulty operation may be caused by the autopositioner subassembly in the front panel subassembly or relay K3303 in the channelizer subassembly. This mechanism is to be checked as outlined in figure 7–96. Removal and replacement of the autopositioner subassembly is described in paragraph 7–216. Relay and other mechanical adjustments are to be performed as described in paragraph 7–219. As most of the troubles that may occur in this subassembly will be mechanical, no test points are assigned.

7–213. When trouble is experienced due to improper tuning in the tuner and power amplifier subassemblies, the servometer B102 may be defective. This can be checked by observing its operation while channeling a new frequency. Where B102 fails to operate, replace as described in paragraph 7–217 and recheck. Always make certain the gear train driven by B102 moves freely and is not jammed before a replacement is made. Continuity of the windings of B102 can be checked with an ohmmeter before attempting a replacement. Reference should be made to figure 7–102 for ohmmeter connections. A normally operating servomotor will have a resistance measurement of 150 ohms for each winding.

7–214. When trouble is experienced in the meter circuit, make certain L101, L102, and M101 are not open or that C104 and C105 are not shorted. (The components C104, C105, L101, and L102 are shown in figure 7–102 but are not used in all models of equipment.) Check the meter switch contacts for correct closure and make certain resistors R101, R102, R104, R114, and R115 have not changed in value. All other circuits on the front panel subassembly are self-explanatory as noted in figure 7–102 and should be checked accordingly.

7–215. REMOVAL AND REPLACEMENT. The three major subassemblies of the front panel subassembly can be removed and replaced as described in paragraphs 7–216 through 7–218.

7–216. Band Change Autopositioner.

a. Tune radio set to an output frequency of 2.0 mc ("BKBB").

b. Remove all power from the equipment.

c. Remove the four screws in the front panel cover and remove the cover.

d. Disconnect P107 from J107.

e. Loosen the three redheaded captive screws and lift the subassembly out of place.

f. When replacing the subassembly, the pin on the slider portion of the coupler must match the 90° cutout of the fixed portion of the coupler.

g. After replacement, tighten the three redheaded screws alternately in small increments until the unit is firmly secured.

h. Insert P107 into J107.

7–217. Servomotor B102. Perform steps a through c of the previous paragraph and disconnect P106 from J106. Continue with steps e through g of the previous paragraph and reinsert P106 into J106.

7–218. Blower Motor B101.

a. Remove the four screws in the front panel and remove the cover.

b. Remove plug P105 from jack J105.

c. Remove the four Phillips-head screws securing the blower to the front panel.

d. To replace blower, reverse steps a through c.

7–219. Autopositioner Relay Replacement and Adjustment. The following procedures are to be performed whenever it is necessary to adjust or replace K101.

a. Set the pawl in a notch of the stop wheel. If necessary, rotate the gear train by hand in order to allow the pawl to seat fully in the notch.

b. Position the relay so the pawl finger lies between the relay spring and frame at about the middle of the spring.

c. Line up the mounting hole farthest from the pawl, and start the mounting screw without applying any pull to the relay spring; i.e., let the relay turn clockwise slightly.

d. Rotate the relay counterclockwise around this screw to permit the pawl finger to slide between the spring and relay arm.

e. Start the second screw into place.

f. Hold the pawl firmly seated in the stop-wheel notch, and hold the relay frame against the pawl finger. Tighten both mounting screws. Make certain that the pawl is firmly seated and the relay armature and arm have no appreciable free play. Reposition, if necessary, to meet these conditions.

SYMPTOM	CAUSE	REMEDY
1. Motor continues to run after autopositioner sets up.	Contacts bent on K101. Spring weak, pawl does not seat fully.	1a. Straighten contacts. Replace relay, replace spring, or remove and bend spring to increase tension. Refer to paragraph 7-219.
	Seeking switch (S102) out of synchronization, causing pawl to drop late and catch on far side of notch.	1b. Adjust switch.
	Intermittent or continuous short on negative side of motor.	1c. Remove cause of short.
2. Autopositioner sets up on wrong channel occasionally.	Broken wire or poor connection on one or more control wires.	2a. Note which channels give ambiguous results. Check control wires for those channels and correct defect. Also check K3303 in channelizer subassembly.
3. Autopositioner sets up on one channel, but continues to run on others.	Control wire shorted to ground.	3a. Note which channel sets up correctly and check control wire for that channel. Correct fault.
	Switch out of synchronization, allowing pawl to drop too early or too late.	3b. Check visually when set up. Realine as necessary.
4. Autopositioner does not set up on any channel, stop wheel turns freely, relay opens momentarily each revolution of shaft.	Spring bent, pawl does not engage stop wheel with sufficient force to hold.	4a. Replace relay, replace spring, or remove and bend spring to increase tension. Refer to paragraph 7-219.
	Switch out of synchronization.	4b. Realine switch.
	Pawl sticks on its pivot.	4c. Remove relay. Remove pawl and clean pivot pin. Reassemble pawl and lubricate pivot with MIL-L-644A oil. Replace and realine relay. Refer to paragraph 7-219.
	Relay shifted. Does not allow pawl to seat properly.	4e. Realine relay. Refer to paragraph 7-219.
	Pawl tip shape severely altered; does not hold.	4f. Remove relay. Replace pawl with new pawl. Reassemble and readjust relay. Refer to paragraph 7-219.
5. Autopositioner does not set up on any channel, stop wheel turns freely, relay remains energized.	Wire from relay to seeking switch shorted to ground.	5a. Find and remove cause of short.
	Several or all control wires shorted to ground.	5b. Find and remove cause of short.
6. Autopositioner does not set up, stop wheel does not turn freely, relay energized, motor runs.	Pawl does not lift clear of notch. Relay shifted away from pawl.	6a. Realine relay. Refer to paragraph 7-219.
	Pawl does not lift clear of notch. Relay has insufficient travel.	6b. Readjust. Refer to paragraph 7-219.
	Driven elements jammed by physical obstruction.	6c. Find and remove obstruction.
	Gear jammed.	6d. Find and remove cause of jam.
	Pawl sticks on its pivot.	6e. Remove relay and pawl. Clean pawl and pivot pin. Replace pawl and lubricate pivot with MIL-L-644A oil. Replace and realine relay. Refer to paragraph 7-219.
	Improper lubrication on bearings at low temperature.	6f. Disassemble and clean bearings as required. Lubricate in accordance with paragraph 7-220.

Figure 7-96. Autopositioner System Trouble Analysis Chart (Sheet 1 of 2)

SYMPTOM	CAUSE	REMEDY
	Insufficient clutch torque due to broken clutch springs.	6g. Replace spring.
	Insufficient clutch torque due to glazing of clutch surfaces.	6h. Replace clutch drum and clutch shoe assembly.
7. Autopositioner sets up, then recycles by itself.	Spring bent, does not hold pawl in notch properly.	7a. Remove spring. Carefully bend spring to increase tension. Reassemble and readjust relay air gap. Refer to paragraph 7-219.
	Relay shifted. Pawl does not seat fully.	7b. Realine relay. Check and readjust air gap if necessary. Refer to paragraph 7-219.
	Pawl tip altered; excessive slope or radius causes pawl to be pushed out of slot.	7c. Remove relay. Replace pawl with new pawl. Reassemble and readjust relay. Refer to paragraph 7-219.
	Intermittent short circuit between control wires or from wires or switch to ground.	7d. Find and remove cause of short.
	Switch out of synchronization, operation marginal.	7e. Realine switch.

Figure 7-96. Autopositioner System Trouble Analysis Chart (Sheet 2 of 2)

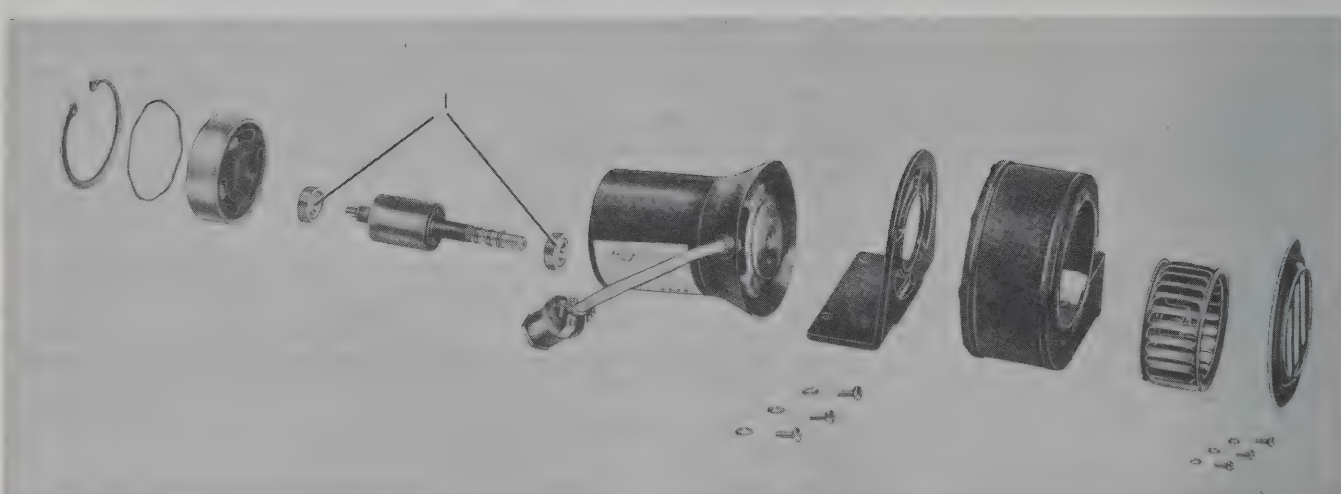


Figure 7-97. Blower Motor B101, Lubrication Points

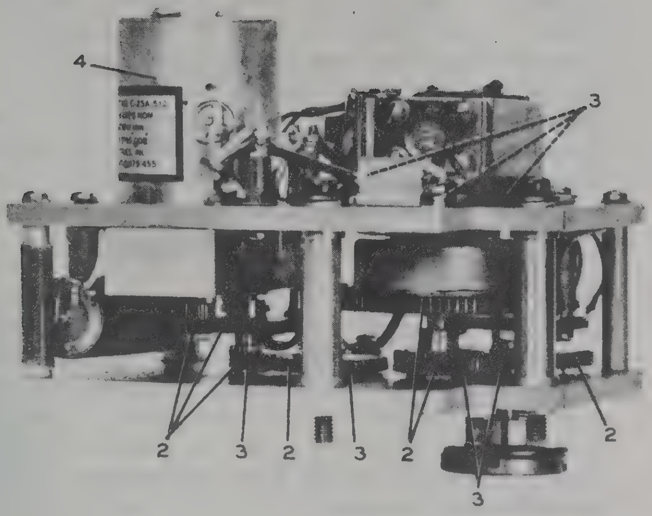


Figure 7-98. Bandchange Autopositioner Unit, Lubrication Points

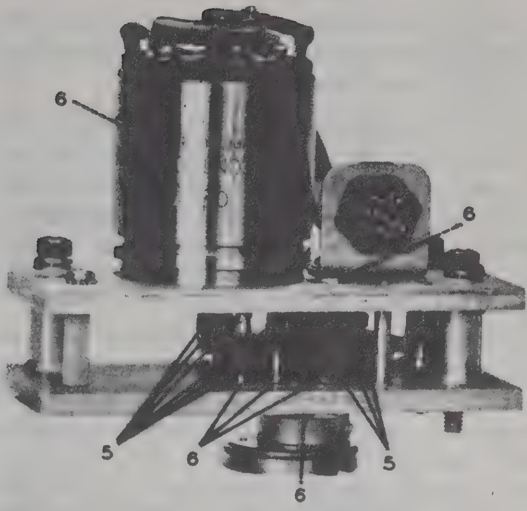


Figure 7-99. Servomotor B102 Unit, Lubrication Points

Subassembly	Detail Part	Reference Number	Figure Number	Lubricant	Method of Application
Blower Motor	Ball Bearings	1	7-97	MIL-G-3278	Brush
Bandchange Autopositioner Unit	Gear Teeth	2	7-98	MIL-G-23827A	Brush
	Ball Bearings	3	7-98	MIL-G-7870	Dropper
	B103 Bearings	4	7-98	MIL-G-7870	Dropper
B102	Gear Teeth	5	7-99	None	Do not lubricate
(Servomotor)	Ball and Motor Bearings	6	7-99	MIL-L-7870	Dropper

Figure 7-100. Front Panel Subassembly Lubrication Data

g. Depress the relay armature, and rotate the relay manually to check the clearance between the pawl tip and the stop wheel. This should be 1/64 inch or less. If adjustment is required, loosen the two screws near the hinge point and slide the hinge plate up or down as required. Adjustment may be facilitated by placing a 0.20-inch feeler gauge between the armature and coil cove. Be careful the frame arm does not rub on the side of the frame and the spring does not shift closer to the contacts when tightening the screws.

h. Check the operation of the relay contacts. With power off, depress the armature of the relay and turn the gearing to let the pawl tip rest on the stop wheel between notches. In this position, the relay contacts should be closed, and the armature and arm should have a small amount of free play to provide full contact pressure at the contact points.

i. If necessary, bend the stationary contacts in or out. Failure to make contact in this position may allow the autopositioner to set up on the wrong position, with the seeking switch circuit open, but with the pawl positioned between notches. Excessive free play of the armature in this position indicates insufficient contact opening in the deenergized position.

7-220. LUBRICATION. All rotating parts of the front panel subassembly should be inspected at 1000-hour intervals. If the parts appear to be clean, sufficiently lubricted, and free running, lubrication can be omitted until the next inspection period. If old lubricant has become hard or dirty, clean the parts to be lubricated with carbon tetrachloride or Stoddard solvent and dry with compressed air. Lubrication is to be performed in accordance with figure 7-100.

CAUTION

The equipment should not be operated after having been cleaned until relubrication procedures have been performed.

7–221. DETAILED CIRCUIT ANALYSIS. As most of the circuits on the front panel subassembly are self-explanatory, only the autopositioner bandchange circuit operation will be described here. Reference must be made to figure 7–101, and paragraphs 7–74, 7–146, 7–147 7–172, and 7–173 in order to understand the complete operation of the circuit.

7–222. Whenever the megacycle "CHANNEL" selector switch on the radio set control is rotated to a new band position, relay K3303 (located in the channelizer subassembly) will operate to provide a ground to the seeking switch S102 (see figure 7–101). The complete ground circuit through the contacts of S102 to the relay coil, causes K101 to operate. The closed contacts on K101 completes the ground circuit to the drive motor B103 and to relays K801 and K804 (located in the relay subassembly) and K1502 (located in the power amplifier subassembly). Operation of K101 also releases the pawl from the notch on the stop wheel. As the stop wheel, seeking switch, and drive motor are all mechanically coupled, releasing of the pawl permits B103 to rotate the seeking switch until a position is reached where the ground circuit from K3303 is open. When this occurs, K101 and B103 are deenergized and the pawl drops into the notch of the stop wheel to lock S102, and the mechanically coupled frequency selection and bandchange circuits of the tuner and power amplifier subassemblies in the desired positions. Simultaneously, the ground circuit to the contacts of relays K801, K804, and K1502 are opened.

7–223. I-F AMPLIFIER SUBASSEMBLY.

7–224. GENERAL DATA. The i-f amplifier subassembly comprises three 250-kc intermediate frequency amplifier stages, the ame detector, avc rectifier, noise limiter circuits, and ame gating circuits. This subassembly is only used when the equipment is operating in the receive mode. R-f input amplifier and mixing circuits contained in the tuner subassembly provide the difference frequency of 250-kc to the input of the i-f amplifier subassembly. As no lubrication is required in this subassembly, the lubrication paragraph has been omitted.

7–225. MINIMUM PERFORMANCE STANDARDS. The following tests are to be performed with the subassembly removed from the main chassis as described in

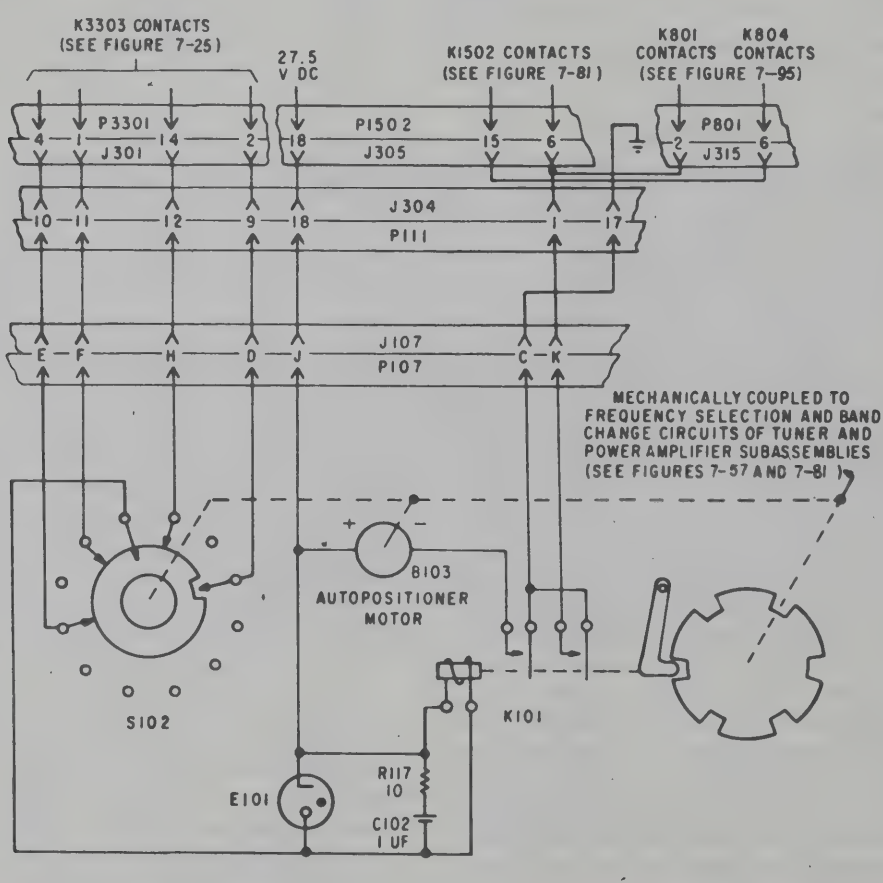
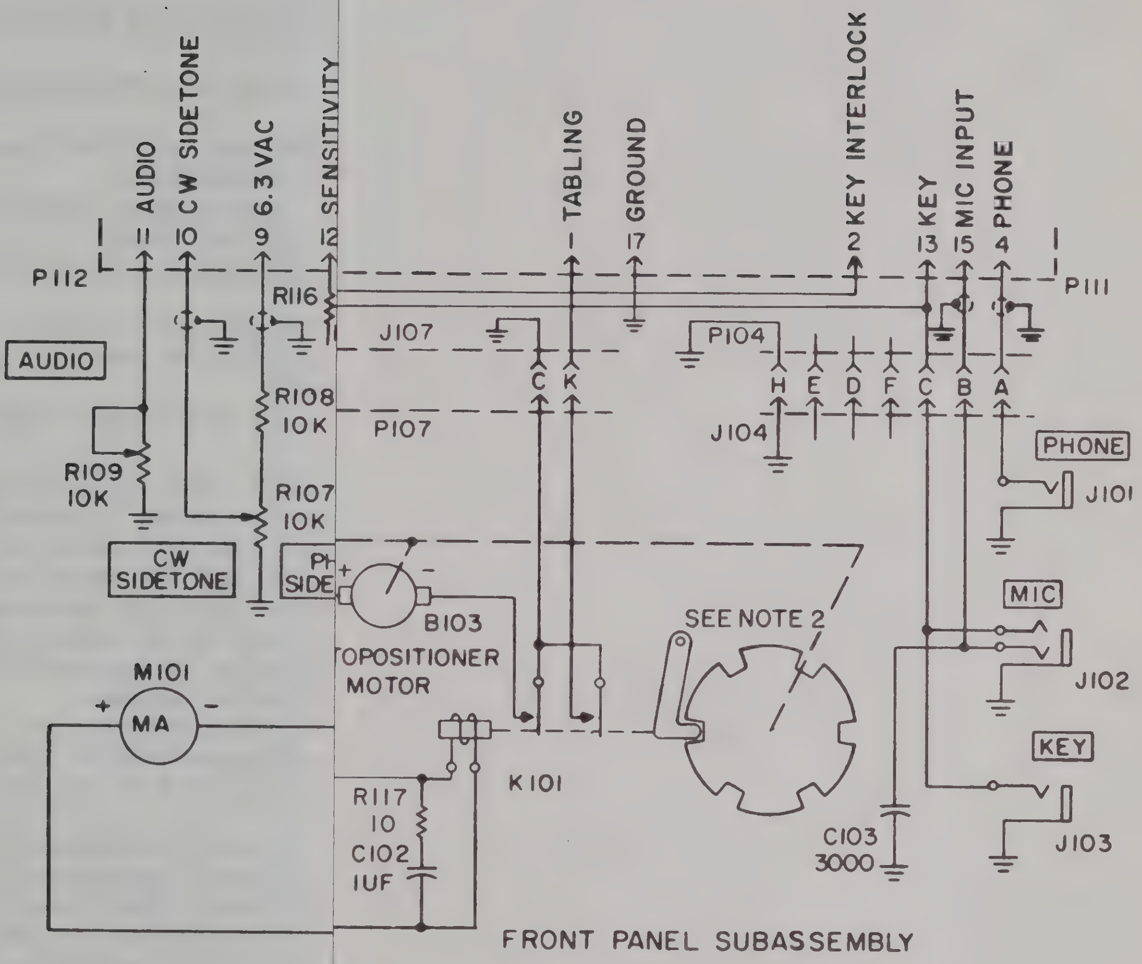


Figure 7–101. Autopositioner Band Change Circuit, Simplified Schematic Diagram



NOTES:

1. ALL RESISTANCE VALUES ARE I
2. PAWL OF BANDCHANGE AUTOPO
OF BANDCHANGE AUTOPOSITIO

Front Panel Subassembly, Schematic Diagram

CAUTION

The equipment should not be operated after having been cleaned until relubrication procedures have been performed.

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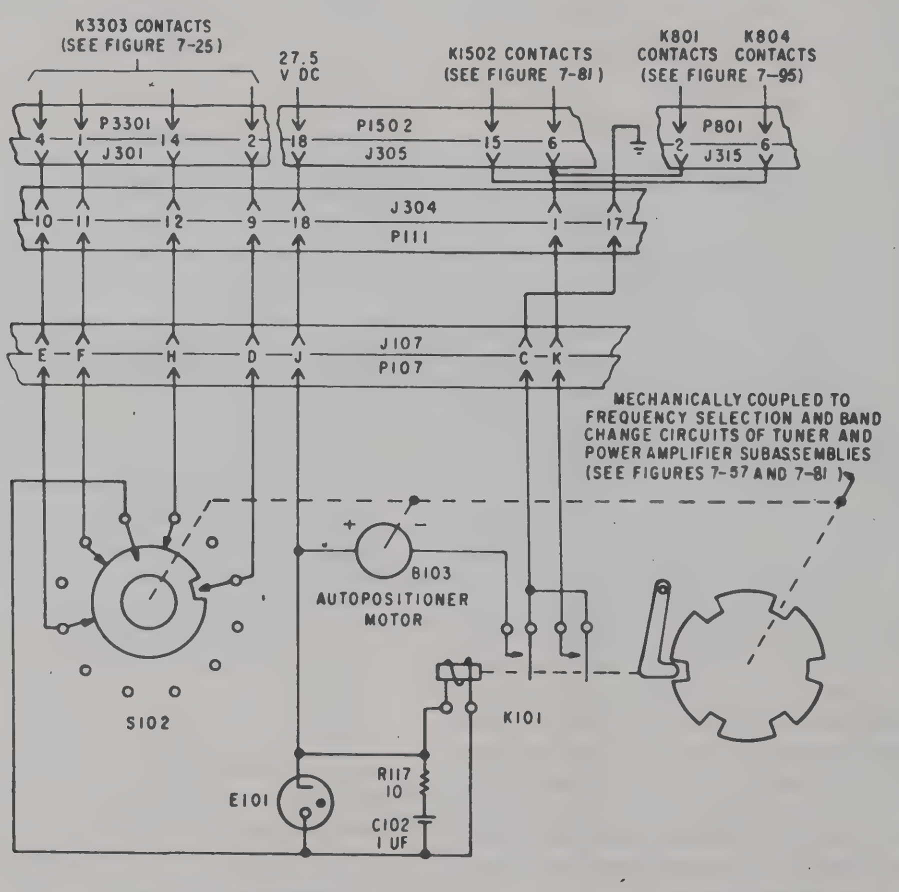
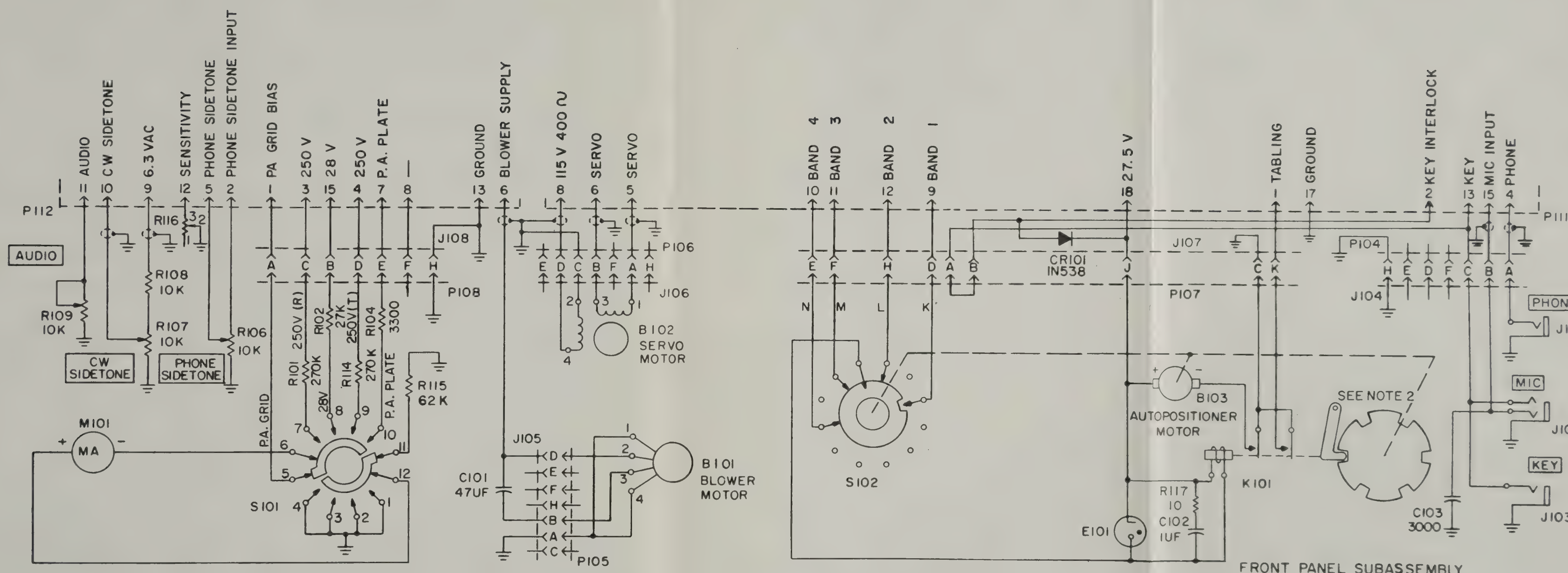


Figure 7-101. Autopositioner Band Change Circuit, Simplified Schematic Diagram



NOTES:

1. ALL RESISTANCE VALUES ARE IN OHMS UNLESS OTHERWISE INDICATED.
2. PAWL OF BANDCHANGE AUTOPOSITIONER UNIT TYPE CHANGED; MOD 3 OF BANDCHANGE AUTOPOSITIONER.UNIT.

Figure 7–102. Front Panel Subassembly, Schematic Diagram

paragraph 7–227. Interconnections between the main chassis receptacle and the subassembly are to be made by means of an extension cable. As only operating power is required for these tests, no wire should be used for interconnecting pin 1 of P901 and J310. All tests are to be performed in the bench test setup shown in figure 2–2. Proceed as follows:

a. Connect the output of the signal generator through a 0.01 uf coupling capacitor to pin 1 of P901 (test point H1). This connection should never be made with power applied as +250-volts is present.

b. Connect the vtvm to P902 (test point H4).

c. Connect the frequency meter to the output probes of the signal generator.

d. Operate the function switch on the radio set control to the "SSB/FSK" position and allow all equipment to warmup for a minimum of 10 minutes.

e. Set the signal generator output to 251.0 kc, ±30 cps monitored by the frequency meter. Adjust the output level of the generator for a reading on the lowest a-c scale of the vtvm.

f. Using this vtvm reading as a reference, increase the output level of the generator to exactly twice the voltage reading.

g. Slowly adjust the frequency above and below the reference frequency (251.0 kc) until the vtvm indicates the original reference voltage reading. Record these frequencies as the 6 db points. Compare with those listed in figure 7-103.

h. Repeat the preceding steps increasing the signal generator output by exactly 1000 times the reference voltage. Record the frequencies above and below resonance as the 60 db points. Compare with those in figure 7–103.

i. Reset the signal generator to 251.0 kc, ±30 cps at an output level of 0.025-volt rms.

j. Note the reading on the vtvm. A minimum reading of 0.3-volt rms should be obtained.

k. Connect the vtvm to pin 5 of P901 (test point H2).

l. Operate the function switch on the radio set control to the "AME" position.

m. Modulate the r-f output of the signal generator 50 percent with a 400 cps audio signal.

n. Adjust the output level on the signal generator until a —1.0-volt d-c reading is obtained on the vtvm.

o. Connect the signal generator to pin 9 of P901 (test point H3) and note the output reading.

p. Set the function switch to the "SSB/FSK" position. The output reading at pin 9 of P901 should drop to at least one-hundredth of that obtained in the previous step.

7–226. CHECK-OUT OR ANALYSIS. This subassembly can be checked as outlined in the trouble analysis chart of figure 7–104. Voltage and resistance measurements for a normally operating unit are shown in figure 7–105. Removal and replacement procedures are described in paragraph 7–227, and when necessary, alinement procedures in paragraph 7–228. All tests are to be made with the subassembly removed from the main chassis and connected in the bench test setup shown in figure 2–2.

7–227. REMOVAL AND REPLACEMENT. Proceed as follows:

a. Remove P902 from jack "J3501" located on the reference oscillator subassembly.

b. Loosen the two redheaded screws securing the subassembly to the main chassis.

c. Pull the subassembly straight up and out of the receptacle.

d. Remove the two screws securing the shield cover in place and slide the shield cover from the top of the subassembly.

e. Reverse the preceding steps in order to replace the subassembly.

7–228. ALINEMENT AND ADJUSTMENT. All of the i-f amplifier subassembly alinement points are shown on figure 7–106. The subassembly should be secured in place on the main chassis and the latter should be connected in a bench test setup similar to that shown in figure 2–2 in order to perform the procedures outlined in the paragraphs that follow.

7–229. Tuned Circuit Adjustments.

a. Remove the second receiver mixer tube, V1006, from the tube socket, and insert a 7-pin tube socket adapter. Refer to figure 7–46 for the location of V1006.

b. Insert V1006 into the tube socket adapter, and connect Signal Generator AN/URM–25 from pin 1 (test point H) to ground. Adjust the AN/URM–25 to 500 microvolts, modulated 30% at 1500 cps, and set the r-f frequency to 251.5 kilocycles with Frequency Meter AN/USM–26.

c. Connect VTVM TS–375/U between terminal 5 of J310 (test point 7) and ground. Adjust to the negative 12-volt scale.

Input from Generator	DB	Low Frequency	Center Frequency	High Frequency
X1	0	Reference	251.0 kc	Reference
X2	6	—1.2 kc min.	251.0 kc	+2.1 kc min.
X1000	60	—2.9 kc max.	251.0 kc	+4.2 kc max.

Figure 7–103. I-F Amplifier Subassembly Selectivity Test Chart

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
1	H1 H3	Signal Generator AN/URM-25, Frequency Meter AN/USM-26, and VTVM TS-375/U	Function control on Radio Set Control CPC-1 set to "AME" position, signal generator connected through 0.01 uf capacitor to pin 1 of P901 and adjusted for output of 251 kc, ±30 cps, modulated 50 percent with 400 cps at 0.025-volt rms. Connect vtvm to pin 9 of P901.	0.3-volt rms minimum. Proceed to step 2.	1a. If no output, proceed to step 2. 1b. If output below normal, check V901, V902, and V903 and all associated voltages and resistances and compare with figure 7-105.
2	H2	Same as step 1	Connect vtvm to pin 5 of P901 and adjust signal generator output until −1-volt d-c is obtained.	−1.0-volt d-c Proceed to step 3.	2a. If still no output at pin 9, check CR901, V904, V905, and all associated voltages and resistances and compare with figure 7-105. 2b. Check C919, C921, C917, and R918 and all other associated parts for quality. 2c. If no reading at pin 5, check V904 and all parts associated with V904B, in particular C918.
3	H1 H3	Same as step 2	Same as steps 1 except operate function switch on Radio Set Control CPC-1 to "SSB/FSK" position. Control vtvm to pin 9 of P901.	Voltage should drop to at least 1/100 of the reading obtained in step 1.	3a. Check CR901 and all associated detail parts.

Figure 7-104. I-F Amplifier Subassembly Trouble Analysis Chart

d. Connect Output Meter TS-585B/U to the PHONE jack (test point 4). Adjust the TS-585B/U to the 500-milliwatt range with an internal impedance of 300 ohms. If desired, Headset H-4/AR or H-1/AR may be connected to either the "PHONE" jack or terminal b of P2601 for aural monitoring. However, to afford proper loading, the TS-585B/U and the H-4/AR or H-1/AR should not be used simultaneously.

e. Operate the function switch to the "AME" position, and allow at least ten minutes for warmup.

f. Adjust the slug of Z901 for maximum indication on VTVM TS-375/U. Tuned circuit Z901 is located on the forward left corner of the i-f amplifier subassembly.

g. Reduce the output level of the AN/URM-25 to 200 microvolts and adjust the signal generator for an output of 1000 cps, 30%-modulation at 251kc.

h. Adjust the slug of Z902 for maximum indication on Output Meter TS-585B/U. Tuned circuit Z902 is located next to Z901.

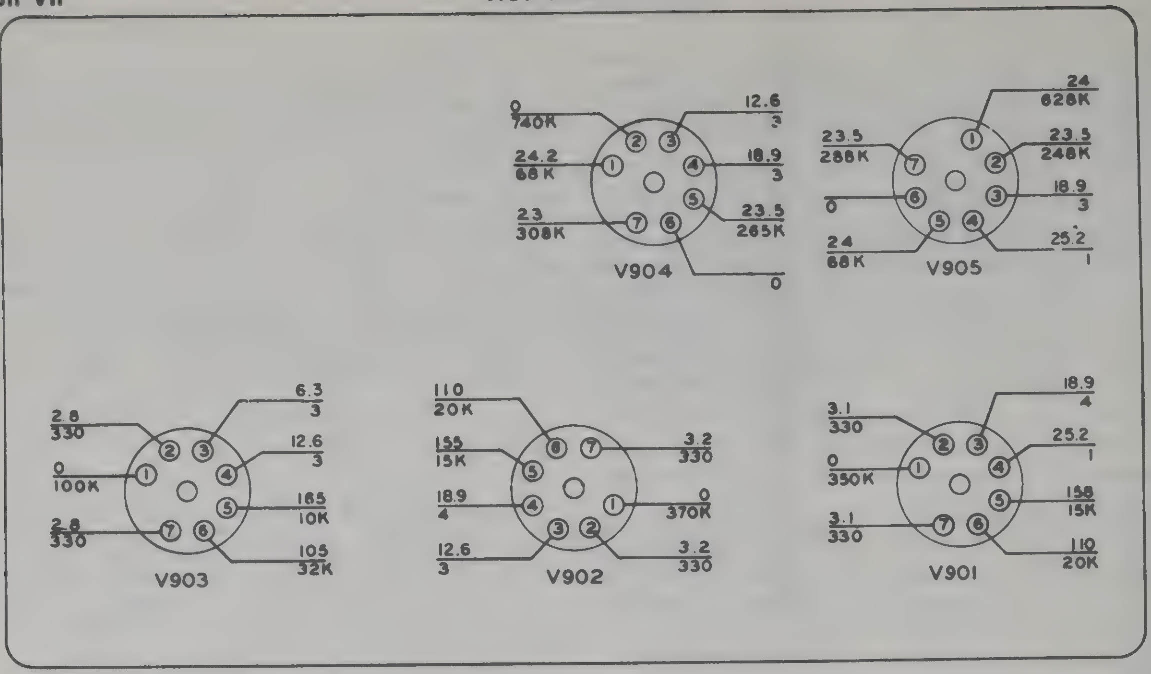
7-230. I-F Gain Adjustments. Maintain the component in the test bench setup, and leave all test equipment connected, as described in the preceding paragraph. Steps a through h of this paragraph will be performed more easily with the i-f amplifier subassembly removed from the main chassis and connected with the proper extension cable. Perform the following operations:

a. With Signal Generator AN/URM-25 still connected to pin 1 (test point H) of V1006, adjust the r-f level to 200 microvolts unmodulated. Reset the AN/URM-25 frequency to 251 kilocycles with Frequency Meter AN/USM-26.

b. Operate the radio set control volume control to the maximum clockwise position.

c. With VTVM TS-375/U still connected to terminal 5 of J310 (test point 7), adjust to the negative 3-volt range.

d. Operate the function switch to the "AME" position, and allow at least 10 minutes for warmup.



NOTES:
1 VOLTAGE MEASUREMENTS TAKEN DURING CW TRANSMISSION.
2 RESISTANCE MEASUREMENTS TAKEN WITH 618S-1/MC REMOVED FROM 350S-1 OR 350S-3 AND P301-14 GROUNDED TO CHASSIS.
3 ALL MEASUREMENTS WITH RESPECT T CHASSIS GROUND
4 P302-10 GROUNDED DURING MEASUREMENTS.
5 ALL VOLTAGES ARE D-C UNLESS OTHERWISE INDICATED.

Figure 7–105. I-F Amplifier Subassembly Tube Voltage and Resistance Diagram

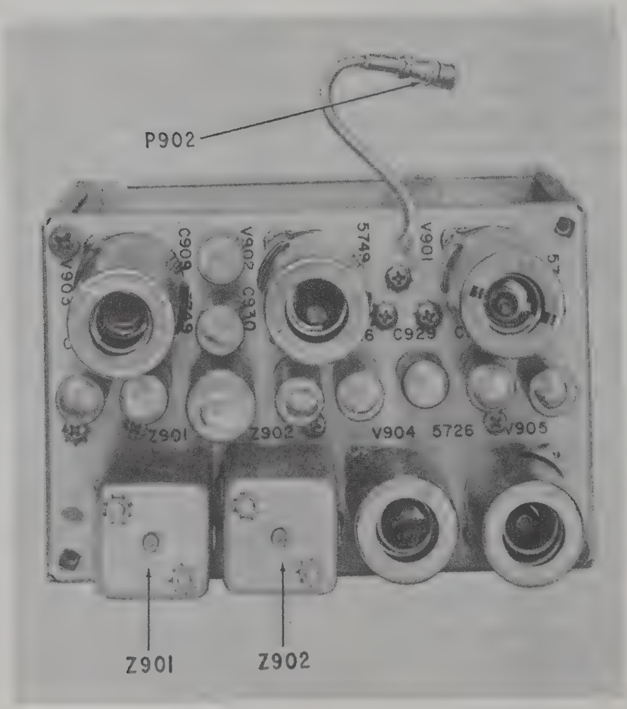
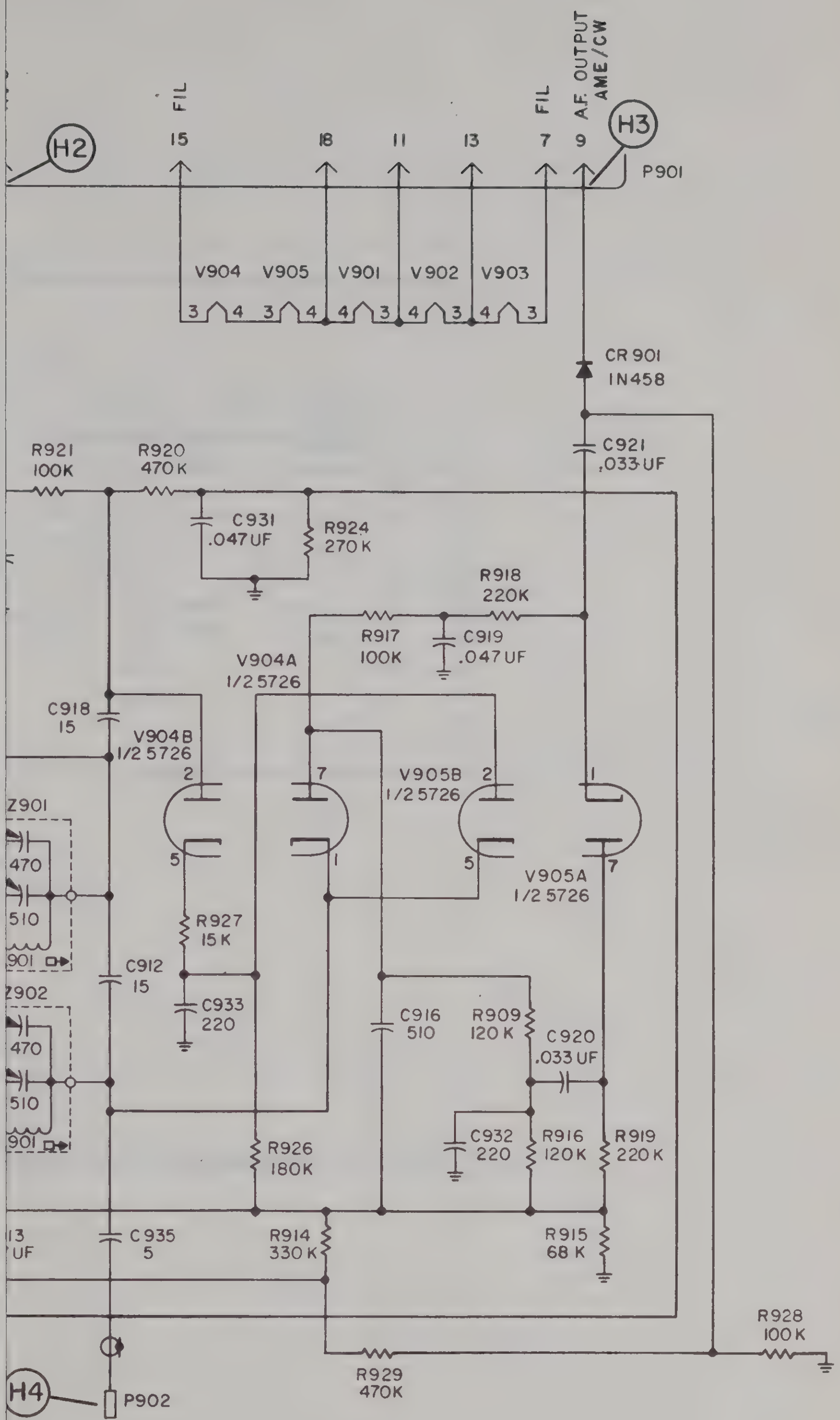
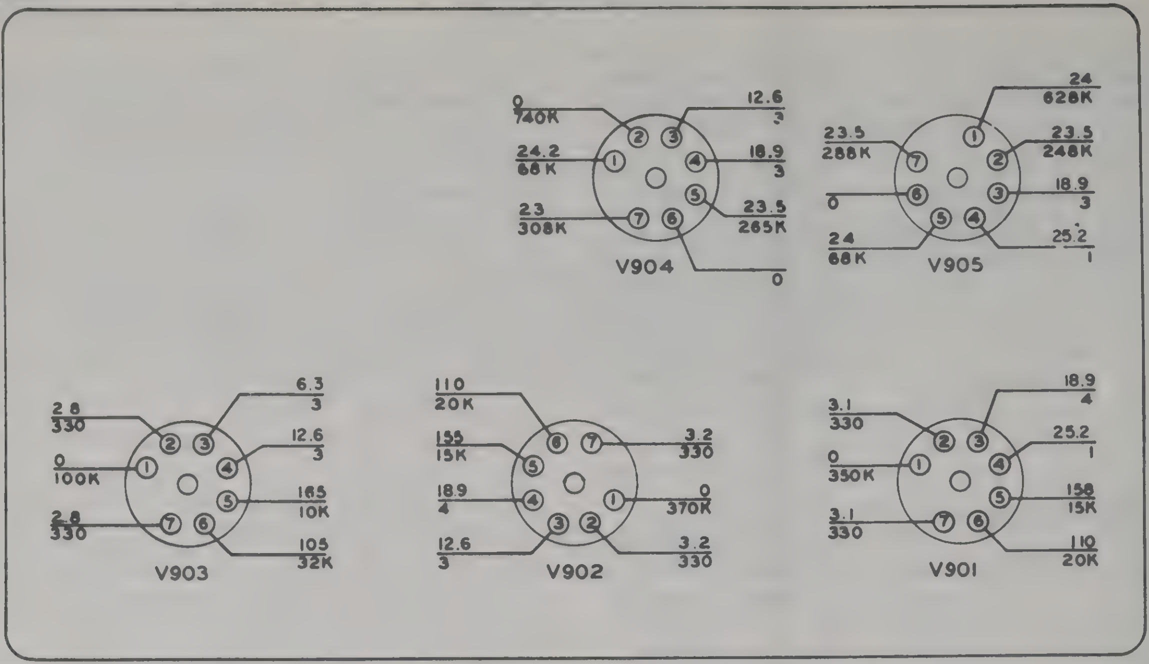


Figure 7–106. I-F Amplifier Subassembly Alinement Points



I-F Amplifier Subassembly, Schematic Diagram



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3 ALL MEASUREMENTS WITH RESPECT T CHASSIS GROUND

4 P302-10 GROUNDED DURING MEASUREMENTS.

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Figure 7–105. I-F Amplifier Subassembly Tube Voltage and Resistance Diagram

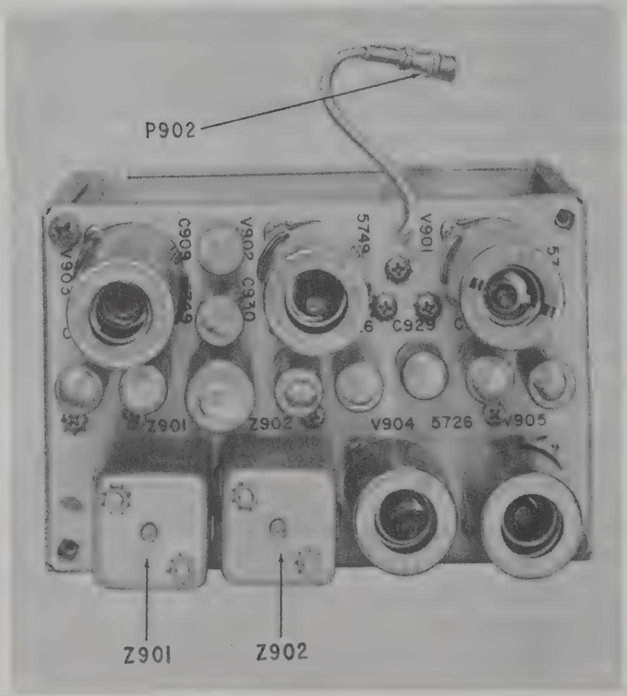
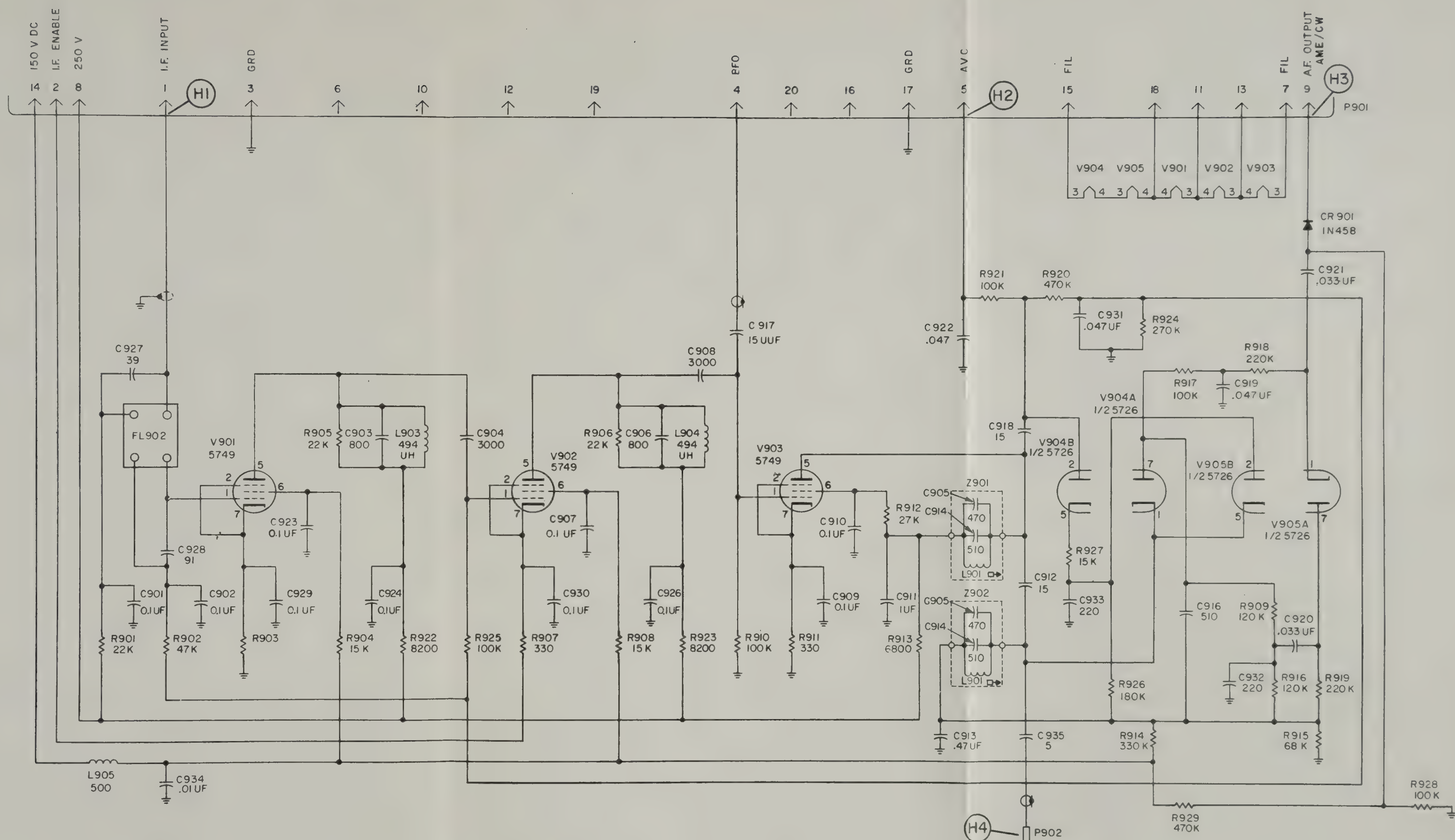


Figure 7–106. I-F Amplifier Subassembly Alinement Points



NOTES
1- RESISTANCE VALUES ARE IN OHMS.
2- CAPACITANCE VALUES LESS THAN 1.0 ARE IN UF AND 1.0 AND ABOVE ARE IN UUF EXCEPT AS INDICATED.

Figure 7–107. I-F Amplifier Subassembly, Schematic Diagram

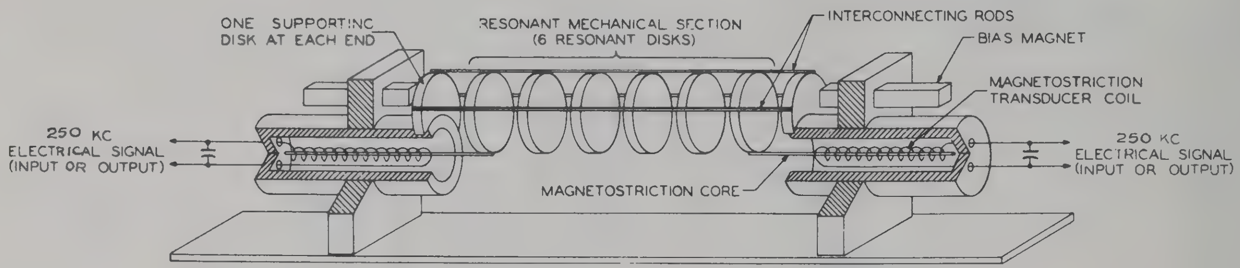


Figure 7–109. Mechanical Filter, Functional Diagram

e. Observe the indication on VTVM TS-375/U. The reading should be approximately −1 volt d-c.

f. Procure values of resistor R903 as follows: 150, 180, 220, 270, 330, 390, and 470. Each resistor is 1/2 watt, ±10%.

g. Remove resistor R903, and replace with various values obtained in step f. Select the resistor which results in VTVM TS-375/U reading closest to −1 volt d-c. Resistor R903 connects from the cathode (pin 7) of V901 to ground.

h. Replace the old R903 with the new resistor determined in step g.

7-231. DETAILED CIRCUIT ANALYSIS. A separate analysis of each of the function circuits of the i-f amplifier subassembly is provided in paragraphs 7-232 through 7-237. In addition, an explanation of the operation of the product detector located in the reference oscillator subassembly, and used for demodulation of single-sideband signals is provided in paragraph 7-238. A simplified diagram is provided where necessary to facilitate the individual circuit explanation.

7-232. Fixed I-F Input Cirucit. Figure 7-108 shows the simplified schematic diagram of the fixed i-f input circuit. The signal from the plate of V1006 is developed across the tuned circuit consisting of the capacitor C927 and the input transducer coil of FL902. The mechanical filter, FL902, employs the principle of magneto-striction to convert electrical energy into mechanical energy and back again, as described in the following paragraph. Output from FL902 is developed across the tuned circuit consisting of C928 and the output transducer coil, and applied to the control grid of the first i-f amplifier, V901. B-plus voltage for the plate of V1006 and avc voltage for the grid of V901 is applied through the transducer coils of FL902. The small d-c current through the transducer coils does not affect the 250-kc signal characteristics.

7-233. Mechanical Filters. The signal from the plate of V1006 is developed across the tuned circuit consisting of C927 and the input transducer coil which resonates to the 250-kc i-f frequency. As noted in figure 7-109, a nickel wire within the input transducer coil is caused to vibrate mechanically from the changing flux created by the input tank current. This mechanical vibration is transferred to the first of six nickel alloy disks. The disks are coupled together by means of nickel interconnecting rods, which vibrate in accordance with the 250-kc signal input. The last disk is connected mechanically to a nickel wire, identical to the wire used on the input side. Vibration of this wire sets up a changing flux, which is picked up by the output transducer coil. An alternating current is setup in the output tuned circuit, which is in direct accordance with the input current. The process by which the electrical input signal is changed to a mechanical vibration, and the reverse process of mechanical to electrical is called magnetostriction. Biasing magnets at each end of the mechanical filter polarizes the resonant disks to prevent frequency doubling in much the same manner that biasing magnets in a headphone prevent the diaphragm from bending in the same direction for both halves of an a-c signal. Each of the nickel alloy disks has a resonant Q exceeding 2000. The disks are overcoupled to produce a response curve with a flat top and straight, almost vertical, sides. Thus, the filter passes a band of frequencies very little wider than the 3500 cps flat top of the selectivity curve.

7-234. I-F Amplifiers. The 250-kc output signal from FL901 is applied to the control grid of the first i-f amplifier stage, V901 as shown in figure 7-110. The i-f signal is amplified by V901 and developed across the tuned circuit comprising L903, C903, and load resistor R905. The i-f signal is coupled through capacitor C904 and developed across grid resistor R925 of the second i-f amplifier stage, V902. The cathode of the second i-f amplifier is connected through resistor R907 to ground through the contacts of K1001 when operating as a receiver. When transmitting, the contacts of K1001 open the cathode circuit to ground to disable the stage. Avc voltage is applied to both the first and second i-f amplifier stages through the avc filter comprising R920, R924, and C931. The output of V902 is developed across the tuned circuit consisting of L904, C906, and load resistor R906, and coupled through capacitor C908 to the control grid of the third i-f amplifier, V903. An injection signal from the beat-frequency oscillator stage also is applied to the control grid of V903. The bfo signal is coupled through capacitor C917 to the control grid of V903. When the bfo is in operation, a heterodyned signal is produced by the mixture of the bfo signal and the i-f signal, resulting in an audio tone for use when receiving cw signals. The i-f signal is amplified by V903 and developed across tuned circuit Z901, which resonates at 250 kc. The 250-kc output signal is applied to the detector, avc, and noise limiter stages as described in the following paragraphs.

7-235. AME Detector, Noise Limiter, and AVC. When operating in the ame and cw modes, one-half of a dual diode tube, V904A, is used as the detector. As shown in figure 7-111, signal voltage is coupled through C912 and applied to the cathode of V904A. Rectified voltage appears across resistors R909 and R916. A series type noise limiter is employed. One-half of dual diode V905 is connected with the first audio amplifier stage (V1301) in the audio amplifier subassembly. Normal audio signals are coupled from the detector output to the control grid of V1301. Sharp, high, amplitude noise pulses are limited in amplitude to a nominal 60-percent modulation characteristics.

7-236. In operation, rectified voltage from the detector load resistors (R909 and R916) is applied to pins 1 and 7 of V905. The plate of the limiter tube is positive and that of the cathode, negative. Capacitor

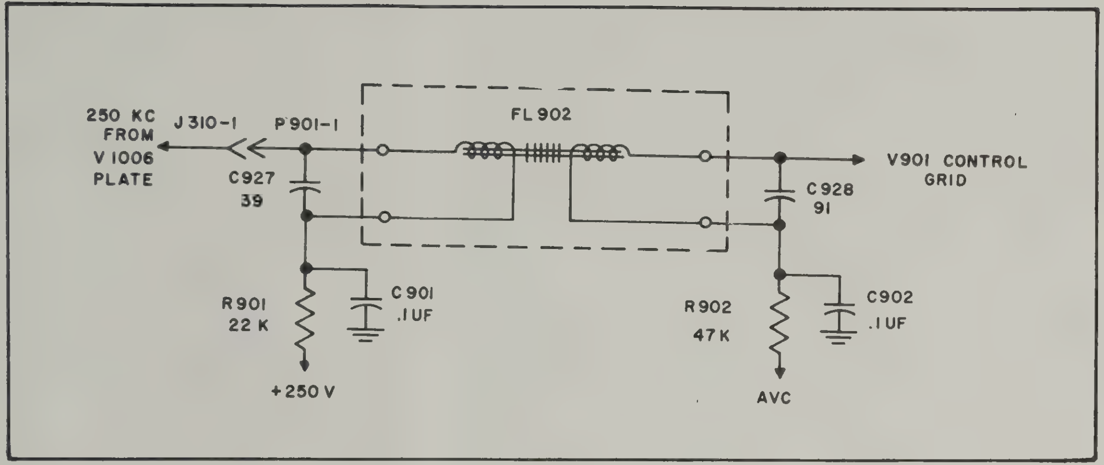


Figure 7–108. Fixed I-F Input Circuit, Simplified Schematic Diagram

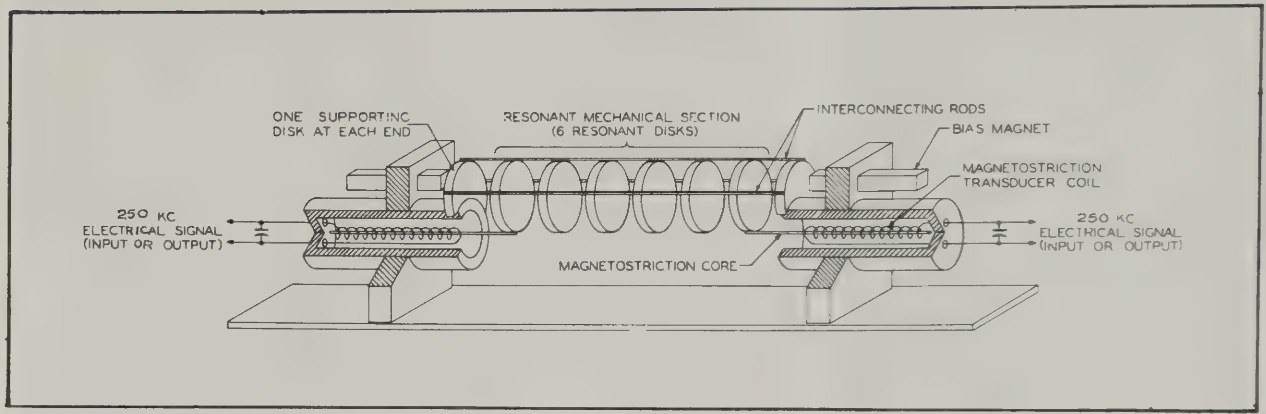


Figure 7–109. Mechanical Filter, Functional Diagram

e. Observe the indication on VTVM TS-375/U. The reading should be approximately —1 volt d-c.

f. Procure values of resistor R903 as follows: 150, 180, 220, 270, 330, 390, and 470. Each resistor is 1/2 watt, ±10%.

g. Remove resistor R903, and replace with various values obtained in step f. Select the resistor which results in VTVM TS-375/U reading closest to —1 volt d-c. Resistor R903 connects from the cathode (pin 7) of V901 to ground.

h. Replace the old R903 with the new resistor determined in step g.

7–231. DETAILED CIRCUIT ANALYSIS. A separate analysis of each of the function circuits of the i-f amplifier subassembly is provided in paragraphs 7–232 through 7–237. In addition, an explanation of the operation of the product detector located in the reference oscillator subassembly, and used for demodulation of single-sideband signals is provided in paragraph 7–238. A simplified diagram is provided where necessary to facilitate the individual circuit explanation.

7–232. Fixed I-F Input Cirucit. Figure 7–108 shows the simplified schematic diagram of the fixed i-f input circuit. The signal from the plate of V1006 is developed across the tuned circuit consisting of the capacitor C927 and the input transducer coil of FL902. The mechanical filter, FL902, employs the principle of magneto-striction to convert electrical energy into mechanical energy and back again, as described in the following paragraph. Output from FL902 is developed across the tuned circuit consisting of C928 and the output transducer coil, and applied to the control grid of the first i-f amplifier, V901. B-plus voltage for the plate of V1006 and avc voltage for the grid of V901 is applied through the transducer coils of FL902. The small d-c current through the transducer coils does not affect the 250-kc signal characteristics.

7–233. Mechanical Filters. The signal from the plate of V1006 is developed across the tuned circuit consisting of C927 and the input transducer coil which resonates to the 250-kc i-f frequency. As noted in figure 7–109, a nickel wire within the input transducer coil is caused to vibrate mechanically from the changing flux created by the input tank current. This mechanical vibration is transferred to the first of six nickel alloy disks. The disks are coupled together by means of nickel interconnecting rods, which vibrate in accordance with the 250-kc signal input. The last disk is connected mechanically to a nickel wire, identical to the wire used on the input side. Vibration of this wire sets up a changing flux, which is picked up by the output transducer coil. An alternating current is setup in the output tuned circuit, which is in direct accordance with the input current. The process by which the electrical input signal is changed to a mechanical vibration, and the reverse process of mechanical to electrical is called magnetostriction. Biasing magnets at each end of the mechanical filter polarizes the resonant disks to prevent frequency doubling in much the same manner that biasing magnets in a headphone prevent the diaphragm from bending in the same direction for both halves of an a-c signal. Each of the nickel alloy disks has a resonant Q exceeding 2000. The disks are overcoupled to produce a response curve with a flat top and straight, almost vertical, sides. Thus, the filter passes a band of frequencies very little wider than the 3500 cps flat top of the selectivity curve.

7–234. I-F Amplifiers. The 250-kc output signal from FL901 is applied to the control grid of the first i-f amplifier stage, V901 as shown in figure 7–110. The i-f signal is amplified by V901 and developed across the tuned circuit comprising L903, C903, and load resistor R905. The i-f signal is coupled through capacitor C904 and developed across grid resistor R925 of the second i-f amplifier stage, V902. The cathode of the second i-f amplifier is connected through resistor R907 to ground through the contacts of K1001 when operating as a receiver. When transmitting, the contacts of K1001 open the cathode circuit to ground to disable the stage. Avc voltage is applied to both the first and second i-f amplifier stages through the avc filter comprising R920, R924, and C931. The output of V902 is developed across the tuned circuit consisting of L904, C906, and load resistor R906, and coupled through capacitor C908 to the control grid of the third i-f amplifier, V903. An injection signal from the beat-frequency oscillator stage also is applied to the control grid of V903. The bfo signal is coupled through capacitor C917 to the control grid of V903. When the bfo is in operation, a heterodyned signal is produced by the mixture of the bfo signal and the i-f signal, resulting in an audio tone for use when receiving cw signals. The i-f signal is amplified by V903 and developed across tuned circuit Z901, which resonates at 250 kc. The 250-kc output signal is applied to the detector, avc, and noise limiter stages as described in the following paragraphs.

7–235. AME Detector, Noise Limiter, and AVC. When operating in the ame and cw modes, one-half of a dual diode tube, V904A, is used as the detector. As shown in figure 7–111, signal voltage is coupled through C912 and applied to the cathode of V904A. Rectified voltage appears across resistors R909 and R916. A series type noise limiter is employed. One-half of dual diode V905 is connected with the first audio amplifier stage (V1301) in the audio amplifier subassembly. Normal audio signals are coupled from the detector output to the control grid of V1301. Sharp, high, amplitude noise pulses are limited in amplitude to a nominal 60-percent modulation characteristics.

7–236. In operation, rectified voltage from the detector load resistors (R909 and R916) is applied to pins 1 and 7 of V905. The plate of the limiter tube is positive and that of the cathode, negative. Capacitor

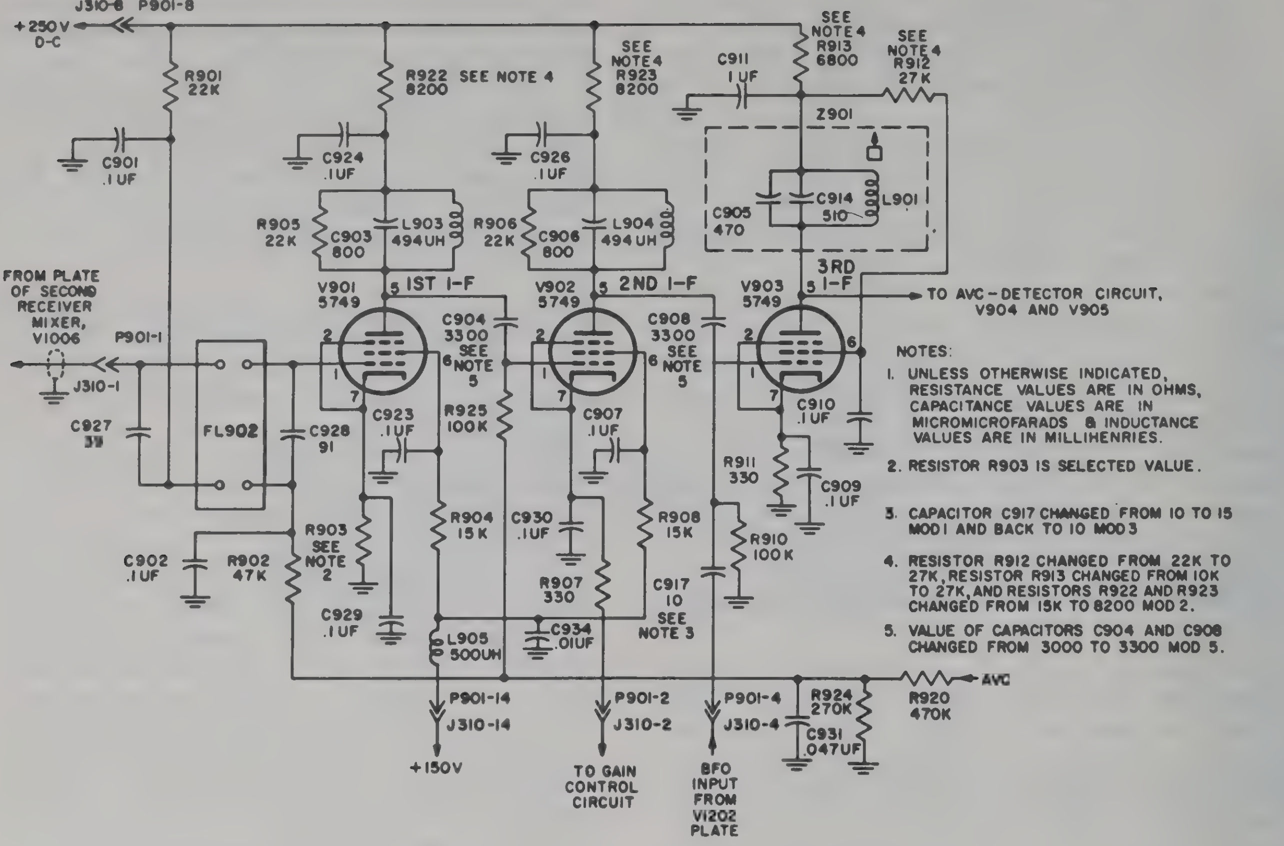


Figure 7–110. I-F Amplifiers, Simplified Schematic Diagram

C919 and resistors R917 and R918 form a filter network to prevent audio voltage from reaching the cathode of the limiter tube. This holds the cathode at a steady potential. Audio voltage reaches the plate of V905A through C920 and controls current flowing through the tube. The current flowing through the tube is proportional to the modulation envelope, and is developed across R918. The resultant voltage is coupled through C921 and the diode CR901 to the grid of the first audio amplifier tube, V1301A. The diode (CR901) conducts only when operating in the cw and ame modes as the anode is maintained at a positive potential through the resistor R929 connected to the +150-volt source.

7–237. Tubes V904B and V905B are employed in a delayed avc circuit. The plate of V904B is coupled to the plate circuit of V903, the third i-f amplifier, through C918. A voltage divider consisting of resistors R914 and R915 is connected between +150 volts dc and ground. The cathode of V904B is connected to the junction of these resistors though isolating resistors R926 and R927, thus providing a delay bias to the avc tubes. A second diode (V905B) is connected from the plate of V903 (through C912) to the junction of resistors R926 and R927. During weak or no signal conditions, the voltage at the junction of R926 and R927 is approximately +25 volts dc, which prevents V904B from conducting until the peak signal voltage at the plate of the third i-f amplifier exceeds 25 volts. Since V905B will start conducting also, the voltage at the junction of R926 and R927 becomes less positive, allowing the avc diode to conduct even more. This results in a more sensitive avc circuit than would be obtained normally using only one avc diode. The d-c voltage obtained from the avc rectifier circuits is supplied to the various controlled stages of the receiver. Avc voltage applied to tubes V901 and V902 is filtered by R920, R924, and C931. Avc voltage supplied to the tuner subassembly is filtered by R921 and C922. These filter components are located in the demodulator chassis. The avc signal to the tuner subassembly is grounded through resistor R807 and contacts of relay K803 when operating in the cw mode. This reduces the avc voltage and increases the gain.

7–238. SSB and FSK Demodulator. Figure 7–111 also shows the circuit used when operating in the ssb or fsk modes. Contacts on the relay K303 operate to remove the ground from the plate of the ssb and fsk demodulator, V3503, located in the reference oscillator subassembly. The operation of this relay also raises the ly to cause the diode to cease conducting. This places a cathode potential on the gating diode CR901 sufficient-high impedance in series with the ame detector and

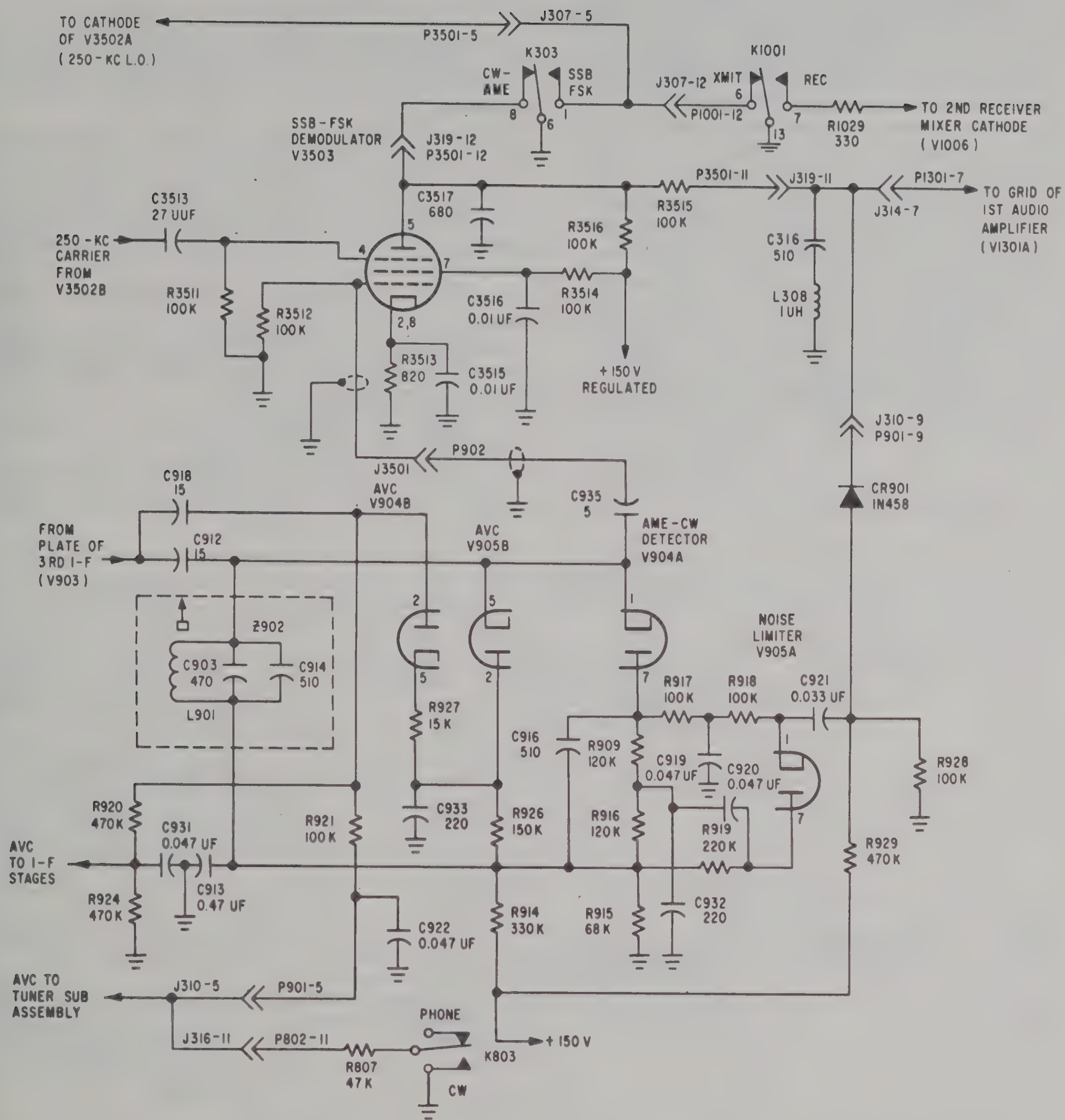


Figure 7-111. Demodulator, Noise Limiter, and AVC Circuits, Simplified Schematic Diagram

audio amplifier to prevent amplitude modulated signals from passing through to the audio amplifier. The i-f signal from V903 is coupled through the capacitors C912 and C935 to the control grid of the ssb demodulator where it is combined with the reinserted 250-kc carrier. The difference signal, which, in this case is the audio modulation, is then amplified and coupled to the grid of the first audio amplifier (V1301A). Contacts on relay K1001 are shown in the transmit position and those on K303 are in the cw, ame position. With the relays operating as shown the cathode of the 250-kc locked oscillator, V3502A, located in the reference oscillator subassembly, is connected to ground through the contacts of K1001. When operating in the ame or cw receive mode (kep-up), the contacts on K1001 operate to ground the cathode circuit of the second receiver mixer, V1006, and remove the ground from the cathode of V3502A as the 250-kc carrier is not required for reinsertion in this type of operation. When operating in the ssb of fsk receive mode, the cathode of V3502A is grounded by the closed contacts on relay K303.

7–239. BFO AND SIDETONE GATE SUBASSEMBLY.

7–240. GENERAL DATA. The bfo circuit of this subassembly is used when operating in the cw receive mode only. The sidetone gate circuit is used to control the selection of the sidetone signals heard in the headset when operation is in the transmit mode. As no lubrication or alinement adjustments are required in this subassembly, these paragraphs have been omitted.

7–241. MINIMUM PERFORMANCE STANDARDS. The following checks are to be performed with the subassembly in place on the main chassis. Proceed as follows:

a. Connect the vtvm to pin 12 of J313 (test point D).

b. Set the function switch on the radio set control to the "CW" position and note the reading on the vtvm after allowing all equipment to warmup for at least 10 minutes. A normal reading will be 1.0-volt rms minimum.

c. Key the transmitter. The voltage should drop to zero.

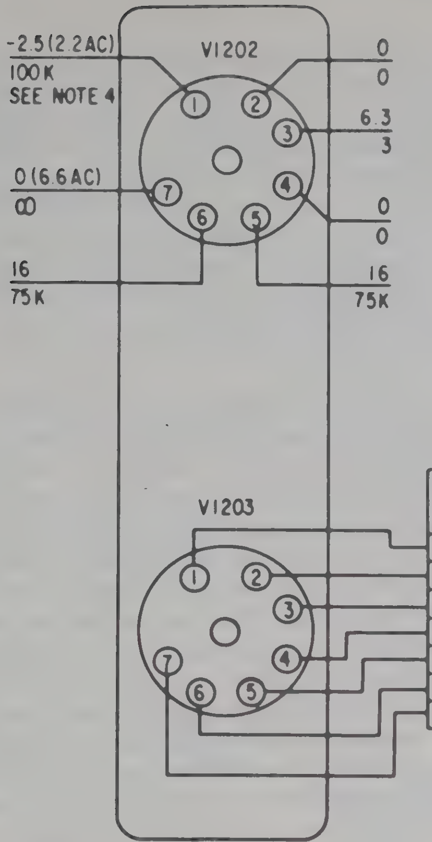
d. Disconnect the vtvm and connect the frequency meter to pin 12. A nominal reading of 1000 cps, ±100 cps will be obtained.

e. Insert a telegraph key into the "KEY" jack and a headset into the "PHONE" jack.

f. Key the transmitter while observing the frequency meter. The reading should drop to zero when the key

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
1	D	VTVM TS–375/U	Function switch on Radio Set Control CPC–1 set to "CW" position. Connect vtvm to pin 12 of P1201.	1.0-volt rms minimum	1a. Check V1202 and all associated voltages and resisatnces and compare with figure 7–121. 1b. Check all associated detail parts for quality. 1c. Check operation of relays K803, and K804 as described in paragraph 7–202.
2	4 6	Headset and telegraph key.	Same as step 1. Insert telegraph key plug into "KEY" jack and headset plug into "PHONE" jack. Key transmitter.	400 cps tone heard in headset. Voltage measured by vtvm at pin 12 drops to zero.	2a. Check as in 1c if voltage does not drop to zero. 2b. If no tone heard, check V1203 and all associated voltages and resistances and compare with figure 7–113. 2c. Check operation of relay K1201.
3	J1	VTVM TS–375/U	Same as step 2.	Volts d-c	3a. Check for voltage at pin 16 of J306. If present check chassis wiring. 3b. If absent, check sidetone gate rectifier circuit components for quality. See figure 7–81 or 7–115.

Figure 7–112. BFO and Sidetone Gate Subassembly Trouble Analysis Chart



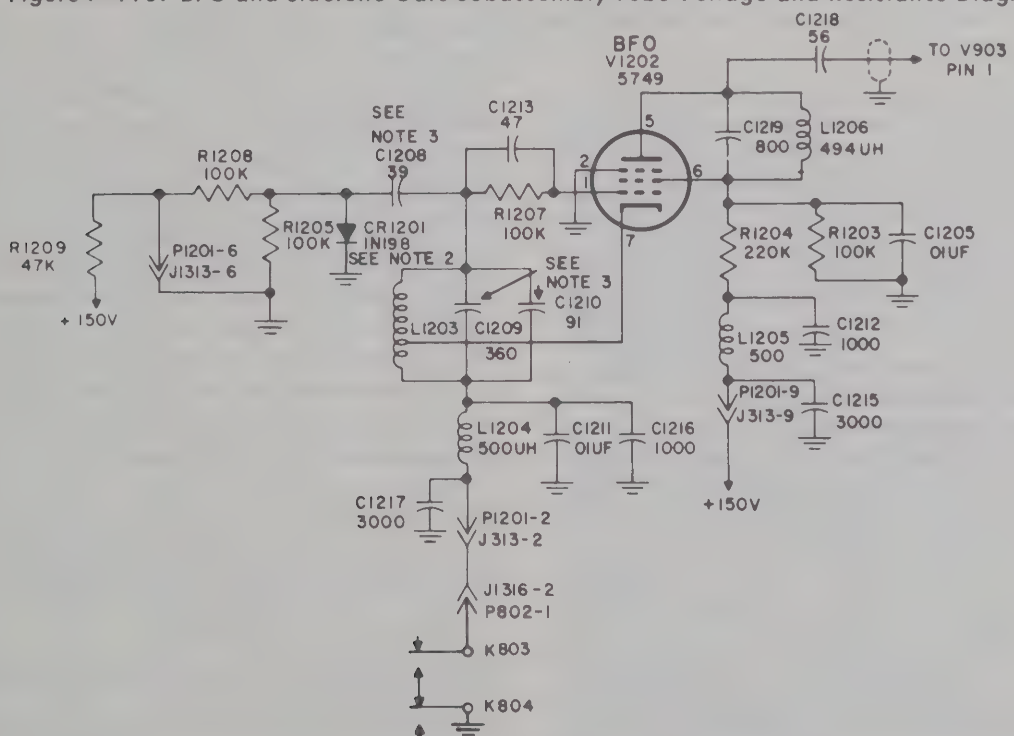
NOTES:

1. V1202 VOLTAGE MEASUREMENTS MADE IN CW RECEIVE MODE.
2. ALL MEASUREMENTS MADE WITH RESPECT TO GROUND.
3. DC READINGS MADE WITH VTVM.
4. RESISTANCE MEASUREMENTS MADE WITH 20,000-OHM-PER-VOLT METER.
5. EQUIPMENT TUNED TO 2.0 MC (BKBB).
6. V1203 MEASUREMENTS MADE IN SSB/FSK TRANSMIT MODE.

TUBE PIN	MODULATED DC	UNMODULATED DC	OHMS
1	5.2	4.0*	200K
2	4.7	4.5*	220
3	6.3	6.3	8.4
4	12.6	12.6	10.0
5	235.0	248.0	8K
6	55.0	80.0	50K
7	4.7	4.5*	220

* INDICATES A VARIABLE READING

Figure 7–113. BFO and Sidetone Gate Subassembly Tube Voltage and Resistance Diagram



NOTES:
1. UNLESS OTHERWISE INDICATED, ALL RESISTANCE VALUES ARE IN OHMS AND ALL CAPACITANCE VALUES ARE IN MICROMICROFARADS.
2. CRYSTAL RECTIFIER CR1201 CHANGED FROM 1N198 TO 1N37A MOD 2.
3. THE FOLLOWING CAPACITORS CHANGED IN VALUE MOD 3: C1208, CHANGED FROM 36 TO 39; C1209, CHANGED FROM 430 TO 360; C1210, CHANGED FROM 20 TO 91.

Figure 7–114. Beat Frequency Oscillator, Simplified Schematic Diagram

is closed and return to normal with the key open and a 400 cps tone should be heard in the headset when the key is closed.

7–242. CHECK-OUT OR ANALYSIS. The checks outlined in the trouble analysis chart of figure 7–112 are to be performed with the subassembly removed from the main chassis and interconnected by means of an extension cable. Removal procedures are described in paragraph 7–243. Figure 7–113 shows the voltage and resistance diagram for this subassembly.

7–243. REMOVAL AND REPLACEMENT. Proceed as follows:

a. Loosen the two redheaded screws securing the subassembly to the main chassis.

b. Pull the subassembly straight up and out of the receptacle.

c. Remove the two screws securing the shield cover in place and slide the shield cover from the top of the unit.

d. Reverse steps a through c in order to replace the subassembly.

7–244. DETAILED CIRCUIT ANALYSIS. As both of the circuits contained in this subassembly function as individual circuits, their operation will be described separately. Operation of the bfo circuit is described in paragraph 7–245 and the operation of the sidetone gate control in paragraph 7–246.

7–245. Beat Frequency Oscillator. The beat frequency oscillator stage, V1202, (located on the sidetone gate subassembly) employs a type 5749 pentode tube in a series-fed electron-coupled oscillator as shown in figure 7–114. The basic oscillator frequency is controlled by the parallel connected combination of the inductor L1203, tuning capacitor C1209, and the temperature-compensating capacitor, C1210. The oscillator plate circuit consists of the screen grid of the tube, the parallel filter arrangement of C1205 and R1203, and the plate load resistor, R1204. Feedback to the grid is accomplished by the autotransformer-type connection of L1203 in the cathode circuit. The parallel arrangement of CR1201 and R1205 is in shunt with the oscillator tank circuit. Diode rectifier CR1201 is connected through R1208, R1209, and L1205 to the +150-volt regulated source. The junction of the two resistors, R1208 and R1209, is connnected to terminal 6 on the plug, P1201. Although this connection is not used in this equipment, it is possible to vary the frequency of oscillations by inserting a variable resistor of approximately 10,000 ohms in series with terminal 6 and ground. This control then can be used to vary the voltage from 0 to approximately 25 volts dc. As the d-c voltage across CR1201 is varied, the impedance to ground is also varied, effectively changing the capacitive reactance of C1208, and altering the frequency of oscillation. In this equipment the oscillator will provide a fixed output frequency of approximately 1,000 cps. Output from the bfo is taken across the plate tank circuit, consisting of C1219 and L1206, and coupled through C1218 to the control grid of the third fixed i-f tube, V903. The bfo stage is disabled when operating in the ame, ssb, or fsk modes. This is accomplished by the series connected sets of contacts on the relays K803 and K804 which opens the ground circuit to the cathode of V1202. The bfo stage is also disabled while transmitting by operation of contacts on the relay K804.

7–246. Sidetone Gate Circuit. Sidetone for cw operation is provided by interrupting a 400-cps signal from a 6.3-volt a-c source located in the Power Supply 416W–1. As noted in figure 7–115, the 400-cps signal is connected through R108 to the high end of the level control potentiometer, R107. The arm of R107 is connected in series with contacts on relays K803 and K804, and the input to the receiver audio amplifier subassembly. The contacts on K803 select the mode of operation and K804 is the keying relay. When operating in the ame or ssb modes, the voice signals from the cathode of V1407B is connected through the contacts of K1201 to the high end of the phone sidetone level control, R106. The arm of R106 is then connected through the contacts of K803 and K804 to the input of the receiver audio amplifier subassembly. Control of the operation of K1201 is provided by the sidetone gate control tube V1203. As noted in figure 7–115, this tube is biased to cutoff by means of the 27.5 volts dc applied to the cathode and the suppressor grid. When the transmitter is modulated, a portion of the r-f signal is converted to dc and used to drive the grid of V1203 positive, causing the tube to conduct. When the tube conducts, relay K1201 will be energized as the relay coil is the plate load of the tube. The modulated r-f signal voltage is developed across the voltage divider comprising resistors R1508, R1521, R1523, and the r-f choke L1505. A small portion of the modulated signal is converted to dc by diode CR1503 and filtered by C1514 and C1540. The positive d-c output voltage appears across the load resistor R1528 and is connected to the control grid of V1203 through the r-f filter choke L321 and the isolating resistor R1214. The latter, in conjunction with the capacitor C1222, is used to attenuate any spurious signals that may develop in the interconnecting wiring.

7–247. AUDIO AMPLIFIER SUBASSEMBLY.

7–248. GENERAL DATA. The audio amplifier subassembly is used to supply the received and sidetone signals to the operator's headset (or intercom) at the desired level. This subassembly is used in both the receive and transmit modes of operation. As no lubrication or alinment adjustments are required in this subassembly, these paragraphs have been omitted.

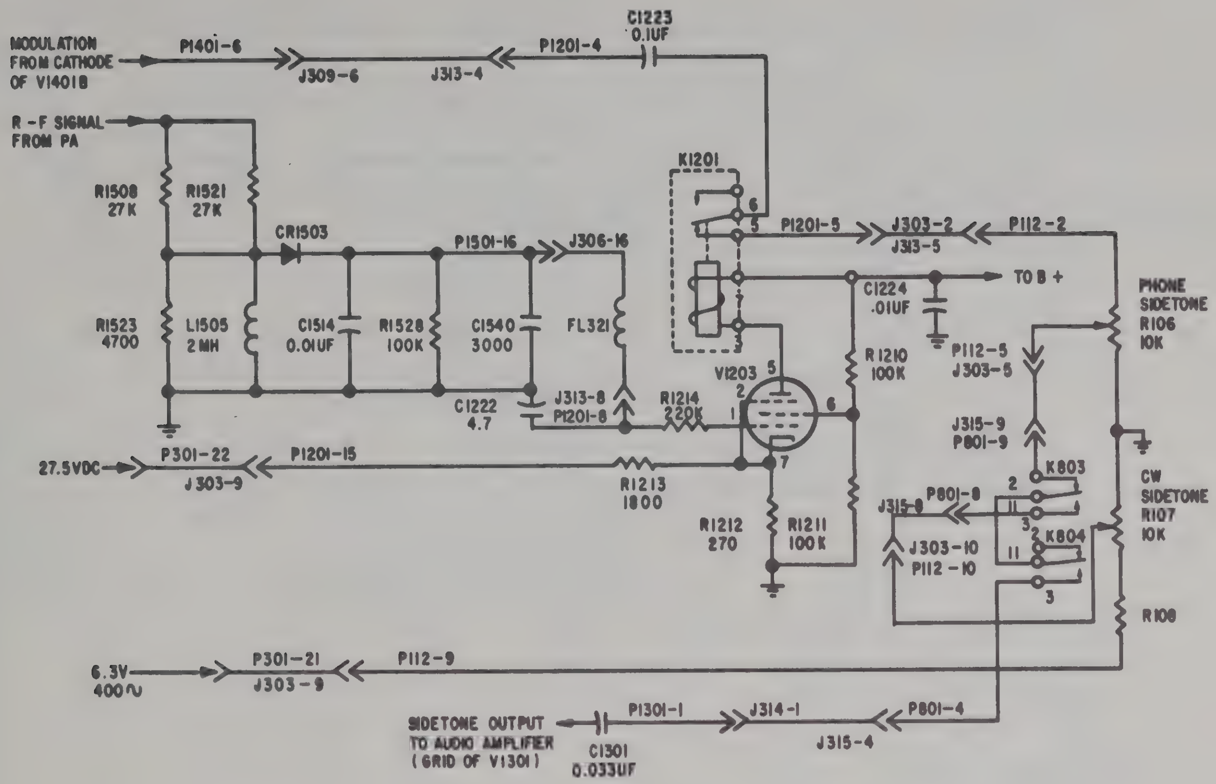


Figure 7-115. Sidetone Gate Circuit, Simplified Schematic Diagram

7-249. MINIMUM PERFORMANCE STANDARDS. The following checks are to be made with the subassembly removed from the main chassis. Power connections to the subassembly must be made by fabrication of an interconnecting cable as described in paragraph 3-7. Do not connect any wires between the number one pins and the number seven pins when making this cable. All checks are to be made in the bench test setup shown in figure 2-2. Proceed as follows:

a. Connect the output of an audio oscillator to pin 7 of P1301 (test point K2).

b. Connect the vtvm to pin 9 of P1301 (test point K3).

c. Set the "VOL" control on the radio set control to maximum clockwise rotation.

d. Set the function switch on the radio set control to the "AME" position.

e. Set the audio oscillator output to 1000 cps at a level of 0.15-volt rms. Note the reading on the vtvm connected to pin 9. This reading should be a minimum of 7.0-volts rms.

f. Insert the headset plug into the "PHONE" jack. A clear 1000 cps tone should be heard.

g. Connect the output of the audio oscillator to pin 1 of P1301 (test point K1) and repeat steps e and f.

h. Connect the output of the audio oscillator to pin 7 of P1301 and adjust for an output of 12.5-volts rms as measured at pin 9.

i. Set the function switch on the vtvm to the db scale and note the reading.

j. Slowly vary the output frequency of the signal generator between 300 and 3500 cps. The variation in db on the vtvm should be less than 3 from the reference value noted in step i.

7-250. CHECK-OUT OR ANALYSIS. These tests are to be performed with the subassembly removed from the main chassis and interconnected by means of the cable fabricated in the previous paragraph. Removal procedures are described in paragraph 7-251. Figure 7-117 is the trouble analysis chart and figure 7-118 is the voltage and resistance diagrams for this subassembly.

7-251. REMOVAL AND REPLACEMENT. Proceed as follows:

a. Loosen the two redheaded screws securing the subassembly to the main chassis.

b. Pull the subassembly straight up and out of the receptacle.

c. Remove the two screws and slide the shield cover from the top of the unit.

d. Reverse steps a through c when replacing the subassembly.

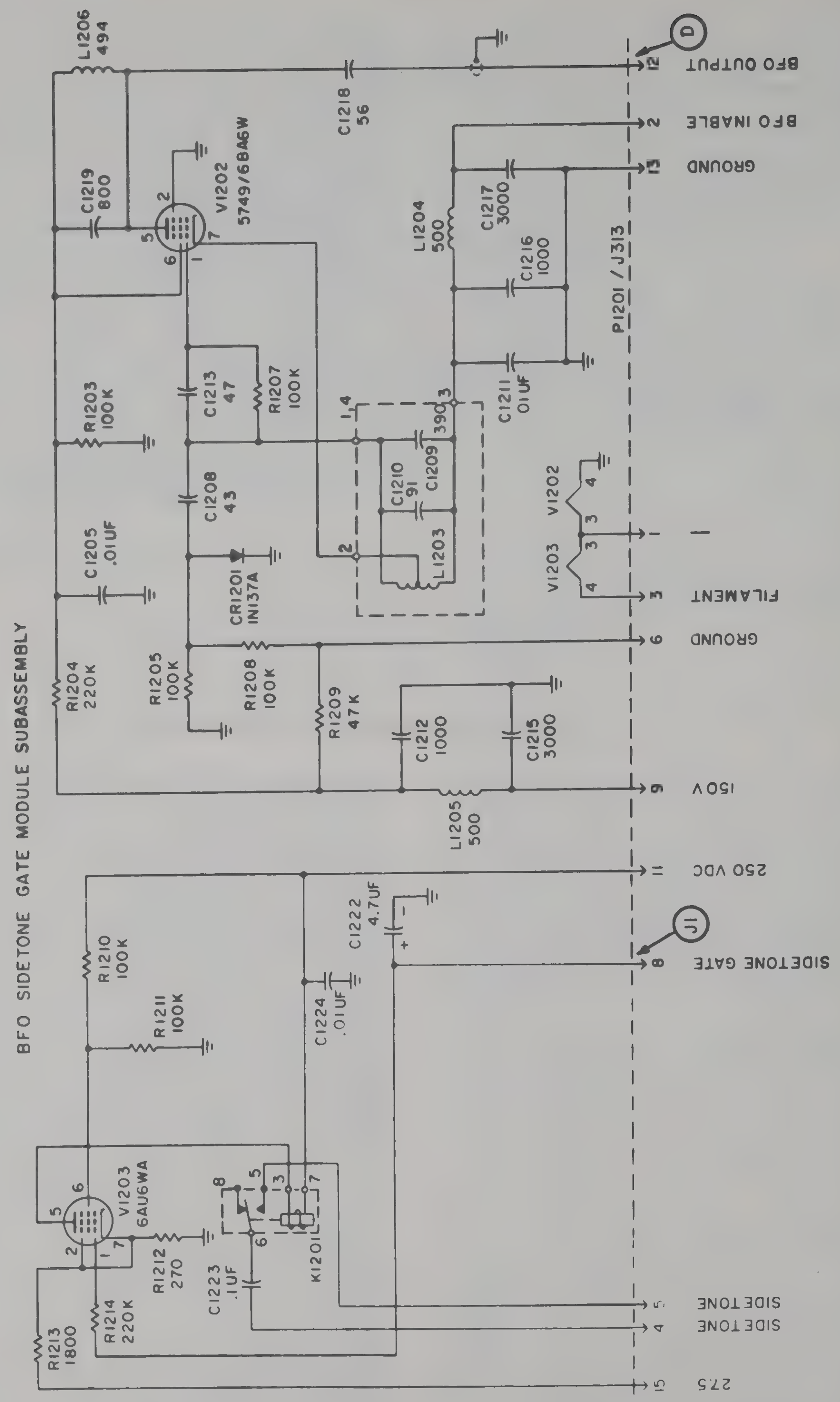


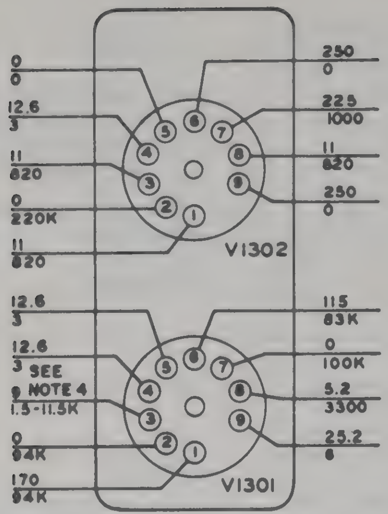
Figure 7–116. BFO and Sidetone Gate Subassembly, Schematic Diagram

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
1	K2 K3	Audio Oscillator TS-382/U and VTVM TS-375/U	Connect audio oscillator to pin 7 of P1301 and adjust for an output of 0.15-volt rms at 1000 cps. Connect vtvm to pin 9 of P1301. Set function switch on Radio Set Control 1 CPC-1 to the "AME" position and "VOL" control to maximum clockwise rotation. Ground pin 5 of P1301	Minimum of 7.0 volts rms	1a. Check tubes V1301, V1302 and all associated voltages and resistances and compare with figure 7-118. 1b. Check all detail parts associated with any abnormal voltage or resistance measurements.
2	K1	Same as step 1	Same as step 1 with audio oscillator connected to pin 1 of P1301	Same as step 1.	2a. Check C1301 and R1303.
3	4 5	Headset and microphone.	Replace subassembly in main chassis and plug headset into "PHONE" jack. Insert microphone plug into "MIC" jack and talk into microphone.	Sidetone should be clearly audible.	3a. Check audio amplifier circuits in modulator subassembly (see paragraph 7-183). 3b. Check sidetone gate circuit (see paragraph 7-242). 3c. Check K803 and K804 in relay subassembly (see paragraph 7-202). 3d. Check operation of relays in main chassis (see paragraph 7-202).
4	6	Telegraph Key	Same as step 3 except insert telegraph key into "KEY" jack and operate function switch on Radio Set Control CPC-1 to "CW" position and key transmitter.	400 cps sidetone clearly audible.	4a. Check wiring from 400 cps source (see figure 7-115). 4b. Check as in steps 3b through 3d.

Figure 7-117. Audio Amplifier Subassembly Trouble Analysis Chart

7-252. DETAILED CIRCUIT ANALYSIS. The audio signal from the cathode of V905A, the plate of V3503, or from the sidetone gating circuit is connected to the audio amplifier subassembly as shown in figure 7-119. The sidetone signal is coupled through capacitor C1301 and the limiting resistor R1303 to the grid of V1301A. The received audio signal from the cathode of the noise limiter V905A, or the single sideband demodulaor, V3503, is coupled through capacitor C1307, directly to the grid of V1301A and developed across the two series connected resistors, R1302 and R1303. The signal is then amplified by V1301A and coupled through capacitor C1302 to the grid of V1301B. A certain amount of control of the amplification of V1301A is obtained by means of potentiometer R116 connected in series with the cathode and ground. Resistor R116 is a screwdriver adjustment, located on the front panel, which can be set during alinement procedures for the nominal operating level. After amplification by V1301B, the signal is coupled through capacitor C1303 to the grid of V1302. The latter tube is the power output stage and will supply approximately 500-milliwatts of audio power to the headset or intercom through output transformer T1301. The potentiometer, R3801, is located in the Radio Set Control CPC-1 to provide an overall adjustment of the received audio signal.

7-253. As shown in figure 7-119, the plate circuit of V1301B is connected through resistor R1312 to the plate of the audio output stage, V1302. The resultant feedback voltage is opposite in phase, and a slight amount of degeneration occurs. This degeneration helps to flatten the frequency response of the audio stages and allows a more linear reproduction of the input signal. The cathode of V1302 is grounded through a set of contacts on relay K1502. Relay K1502 is energized only during the centering cycle of the power amplifier tuning control circuits, thus muting the audio output during this interval and preventing switching transients from being heard in the headset.



NOTES:

1. VOLTAGE MEASUREMENTS TAKEN DURING CW TRANSMISSION.
2. RESISTANCE MEASUREMENTS TAKEN WITH 618S-1/MC REMOVED FROM 350S-1 OR 350S-3 AND P301-14 GROUNDED TO CHASSIS.
3. ALL MEASUREMENTS WITH RESPECT TO CHASSIS GROUND.
4. MEASUREMENT DEPENDS UPON ADJUSTMENT OF AUDIO GAIN CONTROL R109.
5. ALL VOLTAGES ARE D-C UNLESS OTHERWISE INDICATED.

Figure 7–118. Audio Amplifier Subassembly Tube Voltage and Resistance Diagram

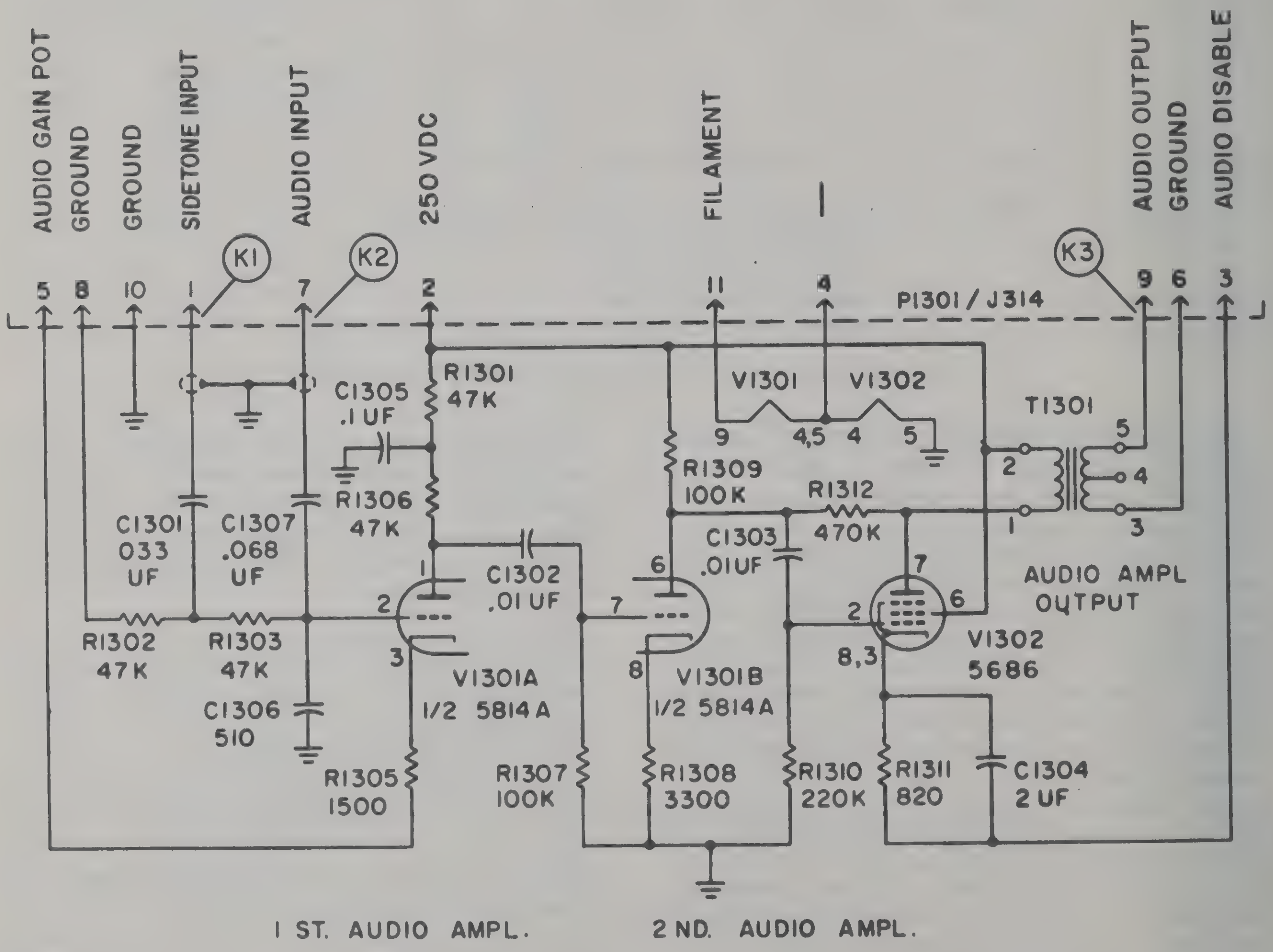


Figure 7–119. Audio Amplifier Subassembly, Schematic Diagram

7-254. MAIN CHASSIS SUBASSEMBLY.

7-255. GENERAL DATA. The main chassis provides the means for mounting and interconnecting all removable subassemblies. In addition, it contains the —65 volt d-c bias supply, four control relays, plugs and jacks for connection to external equipment, and all necessary chokes, bypass, and filter capacitors. When trouble is traced to the main chassis, all interconnections and detail parts associated with the malfunctioning circuit should be checked for open or short-circuits. Figure 7-120 shows checks which should be made point-to-point with an ohmmeter when checking interconnections. When checking for a defective part, the resistance measurements of figures 7-121 and 7-122 should be made. As there are no lubrication or alinement adjustments to be made in the main chassis, these paragraphs have been omitted.

7-256. MINIMUM PERFORMANCE STANDARDS. The tests listed in figures 7-120 through 7-122 are to be used to check for normal operation of the main chassis when trouble is suspected and after a repair has been made. All tests are to be performed with the subassemblies (except the front panel mounted subassemblies) removed from the main chassis. Point-to-point and resistance measurements are to be performed using the ohmmeter circuits of the vtvm. When checking circuits utilizing rectifier diodes, it is necessary to perform the tests with the positive and negative probes of the meter connected as indicated in the tables. A normally functioning diode will always provide a higher backward resistance reading (negative probe connected to anode) than a forward resistance reading (positive probe connected to anode).

From		To	
Part No.	Pin	Part No.	Pin
J301	11	NC	NC
	12	NC	NC
	17	P301	17
	18	NC	NC
	19	NC	NC
J302	2	NC	NC
	2	NC	NC
	4	J308	18
	13	NC	NC
	15	J308	2
	17	P301	17
	18	J308	14
	18	J315	1
	19	J316	14
	19	J310	14
J305	2	NC	NC
	3	J311	8
	4	J311	2
	6	J315	2
	7	J306	6
	9	J306	12
	10	J311	4

From		To	
Part No.	Pin	Part No.	Pin
J305 (cont)	11	J311	6
	13	NC	NC
	15	J315	6
	16*	J306	5
	16*	J311	1
	17	P301	17
	18	J313	15
	19	J308	18
	20	NC	NC
J306	1	J109	"AUX REL ANT"
	2	J307	16
	3	J316	7
	3	J307	20
	4	NC	NC
	7	NC	NC
	8	NC	NC
	9	NC	NC
	10	NC	NC
	11	NC	NC
	13	J316	3
	13	J307	18
	14	NC	NC
	15	NC	NC

* No connection in some equipment

Figure 7-120. Main Chassis Point-to-Point Measurements (Sheet 1 of 4)

From		To	
Part No.	Pin	Part No.	Pin
J306 (cont)	16	J313	8
	17	P301	17
	19	NC	NC
	20	J110	"ANT"
J307	2	J314	2
	3	J312	15
	4	NC	NC
	5	J315	13
	6	NC	NC
	7	NC	NC
	8	NC	NC
	9	NC	NC
	10	J319	8
	10	J309	5
	11	J310	5
	12	J319	5
	14	J313	9
	15	J310	2
	17	P301	17
	19	NC	NC
J308	1	J312	10
	3	NC	NC
	4	J312	4
	5	NC	NC
	6	NC	NC
	7	NC	NC
	8	J311	9
	9	NC	NC
	10	J315	13
	11	NC	NC
	12	J309	11
	14	NC	NC
	16	J308	16
	17	P301	17
	18	J311	14
	19	J315	12
	20	J316	12

From		To	
Part No.	Pin	Part No.	Pin
J309	1	J319	1
	2	J319	4
	3	J316	4
	6	J313	4
	7	NC	NC
	8	J316	5
	10	J310	7
	13	P301	17
	14	J309	15
	15	J310	18
	15	J319	13
J310	3	NC	NC
	4	J313	12
	5	J316	11
	6	NC	NC
	7	J319	6
	8	J314	2
	8	J316	13
	9	J319	11
	10	NC	NC
	11	NC	NC
	12	NC	NC
	13	NC	NC
	15	J313	3
	16	NC	NC
	17	P301	17
	18	J312	7
	19	NC	NC
	20	NC	NC
J311	3	J312	3
	5	P301	17
	7	J312	5
	9	J312	9
	9	J316	13
	10	NC	NC
	12	NC	NC
	13	P301	17

Figure 7-120. Main Chassis Point-to-Point Measurements (Sheet 2 of 4)

From		To	
Part No.	Pin	Part No.	Pin
J311 (cont)	14	J312	7
	14	J302	4
	15	J312	14
J312	1	P301	17
	4	J316	2
	6	J316	15
	12	NC	NC
	13	P301	17
J313	1	NC	NC
	2	J316	1
	6	P301	17
	7	NC	NC
	9	J316	14
	10	NC	NC
	11	J314	2
	13	P301	17
	14	NC	NC
J314	4	NC	NC
	8	P301	17
	9	J101	"PHONE"
	10	P301	17
J315	5	P301	17
	7	J319	15
	14	NC	NC
	15	NC	NC
J316	10	NC	NC
J319	14	P301	17
P301	1	J306	18
	2	NC	NC
	4	J305	8
	5	NC	NC
	6	J302	12
	7	J315	10
	8	J102	"MIC"

From		To	
Part No.	Pin	Part No.	Pin
P301 (cont)	9	NC	NC
	10	J301	20
	11	NC	NC
	12	J102	"MIC"
	12	J103	"KEY"
	14	J312	9
	15	J307	1
	15	J309	9
	16	NC	NC
	17	P301	18
	19	NC	NC
	20	NC	NC
	21	J311	3
	22	P301	23
	22	P302	23
	22	J313	15
	24	NC	NC
	25	NC	NC
	26	NC	NC
	27	J314	6
	28	J316	9
	29	J315	11
	30	NC	NC
	31	J316	3
	32	NC	NC
P302	1	J301	9
	2	J301	5
	3	J301	10
	4	J301	6
	5	J302	5
	6	J301	7
	7	J302	6
	8	J301	8
	9	J302	7
	11	J302	8
	12	NC	NC
	13	J302	9
	15	J302	10

Figure 7–120. Main Chassis Point-to-Point Measurements (Sheet 3 of 4)

From		To	
Part No.	Pin	Part No.	Pin
P302 (cont)	17	P301	17
	18	P301	17
	19	J302 4	14
	20	J302	11
	21	J314	19
	22	J302	16
	23	P302	24
	23	J308	15
	24	J302	20
	24	J315	20
	25	NC	7
	26	NC	NC
	27	NC	NC
	28	J315	3
	29	NC	NC
	30	J314	1
	31	J315	4
	32	NC	NC
P301	17	C302	Ground
		C303	Ground
P301	17	C306	Ground
		C310**	Ground
		C311	(+)
		C313	Ground

From		To	
Part No.	Pin	Part No.	Pin
P301 (cont)		C317	Ground
		C318	Ground
J107	A	P301	12
	B	J316	8
	C	P301	17
	D	J301	2
	E	J301	4
	F	J301	1
	H	J301	14
	J	J305	18
	K	J305	6
P303	Yellow	J301	13
P304	Green	J301	15
P305	White	J301	16
C302	1	J311	11
C303	high	J312	11
C305	high	J308	2
C306	high	J302	4
C310**	high	J310	1
C317	high	J314	9
P112	12	J307	13

** Not used in some equipment

Figure 7-120. Main Chassis Point-to-Point Measurements (Sheet 4 of 4)

From (+Probe)		To (—Probe)		VTVM Range Setting	Nominal Resistance (ohms)	Circuit or Parts Checked
Part No.	Pin	Part No.	Pin			
C311	(-)	J301	3	Rx1K	10,000	CR302, R313, R315, R316, R317, R318
C311	(-)	P301	4	Rx10	370	CR301, R312
J301	3	C311	(-)	Rx1K	15,000	CR302, R313, R315, R316, R317, R318
	3	J319	7	Rx1K	8,000	CR302, R315, R316, R317, R318
J302	1	J319	10	Rx10	25	L307
	4	J314	11	Rx10	37	R307

Figure 7-121. Main Chassis Resistance Measurements (Sheet 1 of 3)

From (+Probe)		To (—Probe)		VTVM Range Setting	Nominal Resistance (ohms)	Circuit or Parts Checked
Part No.	Pin	Part No.	Pin			
J305	1	J108	E	Rx10	0	Meter select
	14	J319	15	Rx100	700	K305
J307	1	J319	3	Rx10K	33,000	R311
J308	8	J108	C	Rx10	0	Meter select
	15	J308	18	Rx10	2	R306
J309	9	J108	D	Rx10	0	Meter select
J310	9	J314	7	Rx1K	15,000	R323
	9	C316	E306	Rx10	0	
J312	2	J312	8	Rx10	150	B102
J313	5	P301	17	Rx1K	10,000	R106
J319	3	C313		Rx10	0	
	7	J108	A	Rx10	0	Meter select
	7	J301	3	Rx1K	5,600	CR302, R315, R311, R317, R318
	10	C318		Rx10	0	
	15	P301	7	Rx10K	25,000	CR303, K302
	15	P302	16	Rx10K	26,000	CR303, K302
P301	3	P301	17	Rx10	22	B801
	4	P301	17	Rx10	160	B802
	4	C311	(–)	Rx100K	1,000,000 min.	CR301, R312
	7	J319	15	Rx10K	Infinite	CR303, K302
	12	P302	16	Rx10K	31,000	CR304
	13	J308	15	Rx10	280	K301
	17	J108	H	Rx10	0	
	17	C305	ground	Rx10	0	L302
	17	C316	ground	Rx10	16	L308
	21	P301	17	Rx10K	20,000	R107, R108
	23	J108	B	Rx10	0	
P302	10	J319	15	Rx100	725	K302
	16	P301	12	Rx10K	Infinite	CR304
	16	J319	15	Rx10K	Infinite	CR305, K302

Figure 7–121. Main Chassis Resistance Measurements (Sheet 2 of 3)

From (+ Probe)		To (- Probe)		VTVM Range Setting	Nominal Resistance (ohms)	Circuit or Parts Checked
Part No.	Pin	Part No.	Pin			
J308	2	J308	18	Rx100	1200	CR306, R327
J308	18	J308	2	Rx10K	150,000	CR306, R327
J303	1	J308	2	Rx1K	5300	R324, R325 R326

Figure 7-121. Main Chassis Resistance Measurements (Sheet 3 of 3)

From		To		VTVM Range Setting	Nominal Resistance (ohms)	Circuit or Parts Checked	Remarks
Part No.	Pin	Part No.	Pin				
J314	5	P301	17	Rx10	10 maximum	R109	"AUDIO" control maximum clockwise.
J314	5	P301	17	Rx1K	10,000	R109	"AUDIO" control maximum CCW.
J315	8	P301	17	Rx1K	10,000	R107	"CW SIDETONE" maximum clockwise.
J315	8	P301	17	Rx10	10 maximum	R107	"CW SIDETONE" maximum CCW.
J315	9	P301	17	Rx1K	10,000	R106	"PHONE SIDETONE" maximum clockwise.
J315	9	P301	17	Rx10	10 maximum	R106	"PHONE SIDETONE" maximum CCW.
P301	17	P309	3	Rx10	0	K301	K301 energized.
	17	J306	6	Rx10	0	K301	
	17	J316	6	Rx10	0	K301	K301 deenergized.
	17	J309	4	Rx10	0	K303	K303 deenergized.
	17	J319	5	Rx10	0	K303	K303 energized.
	17	J319	12	Rx10	0	K303	K303 deenergized.
	17	J314	3	Rx10	0	K305	K305 energized.
P301	8	J309	12	Rx10	0	K302	K302 deenergized.
P302	14	J309	12	Rx10	0	K302	K302 energized.
J305	5	J307	1	Rx10	0	K301, K302	K301, K302 deenergized.
	5	J307	1	Rx100	4,000	K301, K302, R301	K302 deenergized. K302 energized.
	5	J307	1	Rx100	4,000	K301, K302, R301	K301 energized. K302 deenergized.
	12	J319	7	Rx100	4,700	K301, K302, R314	K301 deenergized. K302 energized.
J305	12	J319	9	Rx10	0	K302	K302 deenergized.

Figure 7-122. Main Chassis Relay and Level Control Resistance Measurements

7-257. CHECK-OUT OR ANALYSIS. The checks listed in the previous paragraph should be performed when a defect is traced to the circuits contained in the main chassis or front panel subassemblies. Where the defective circuit is known, only the associated parts or wiring listed in figures 7-120 through 7-122 need be checked. Figure 7-124 is the schematic diagram of the main chassis and figure 7-125 is the schematic diagram of the filter unit used with this equipment. This filter is connected in series with the main chassis receptacles P301 and P302 and all externally connected components. Therefore, continuity checks between the various filter input and output connections should be made to make certain there are no open or short-circuits that would prevent normal operation of the radio set.

7-258. REMOVAL AND REPLACEMENT. All parts mounted on the main chassis are secured in place by means of mounting studs, clamps, and associated hardware. Care must be exercised to replace all securing hardware associated with any replaced part. Always make certain that the wiring to a replaced part is dressed in the correct manner. Where cable clamps are removed in order to make a replacement, always make sure the clamps are replaced so the cable will be held in correct position during operation. If ever a multi-pin receptable is replaced, always tag the wires as they are unsoldered from the pins of the receptacle in order to assure correct replacement.

7-259. DETAILED CIRCUIT ANALYSIS. It will be noted in figure 7-124, that the only complete circuits contained on the main chassis are the −65-volt bias supply and the limiting circuit. With a partial exception of the relays, the function of all other parts mounted on the main chassis have been explained in the various filament and power distribution paragraphs. Figure 7-123 lists the operation and function of the relays K301, K302, K303, and K305. There is no relay K304 used in this equipment. The −65-volt bias supply obtains input power from the 115-volt, 400 cps power source connected to pin 4 of P301. Current limiting is provided by R312 which is in series with the power source and the rectifier diode CR301. The latter converts the a-c input source to d-c which is smoothed by the action of the capacitor C311. The resistance string comprising R313, and R315 through R318 is a voltage divider which is used to drop the voltage to −65 volts in order to provide operating bias for the power stages, and −24 volts to provide operating bias for the dual crystal oscillator subassembly. The d-c return path for the bias supply is provided by the resistance divider in the latter subassembly. Regulation of the d-c voltage is provided by the Zener diode CR302 connected in parallel with R315 through R318.

7-260. The limiting circuit, consisting of diodes CR306 and CR307, prevents the positive peaks of switching transits, appearing at the plate of diode CR306, from exceeding an amplitude of +6.2 volts. The limiting level is provided by zener diode CR307 which clamps the cathode of diode CR306 at approximately +6.2 volts. Resistor R327 isolates the 6.2 volt clamp from the filament supply.

Operating Mode		PA		CW		AME		SSB		FSK	
Relay	Function	Tune	Home	Trans.	Trans.	Trans.	Trans.	Rec.	Rec.	Rec.	Rec.
K301	Tune-Operate	X	O	O	O	O	O	O	O	O	O
K302	Phone/SSB–Tune/CW/FSK	X	O	X	X	O	O	O	O	X	O
K303	CW/AME–SSB/FSK	*	O	O	O	O	O	X	X	X	X
K305	Home-Tune/Operate	X	O	X	X	X	X	X	X	X	X

Legend:
X = Relay energized
O = Relay deenergized
* = Depends upon setting of function switch

Figure 7-123. Main Chassis Mounted Relay Functions

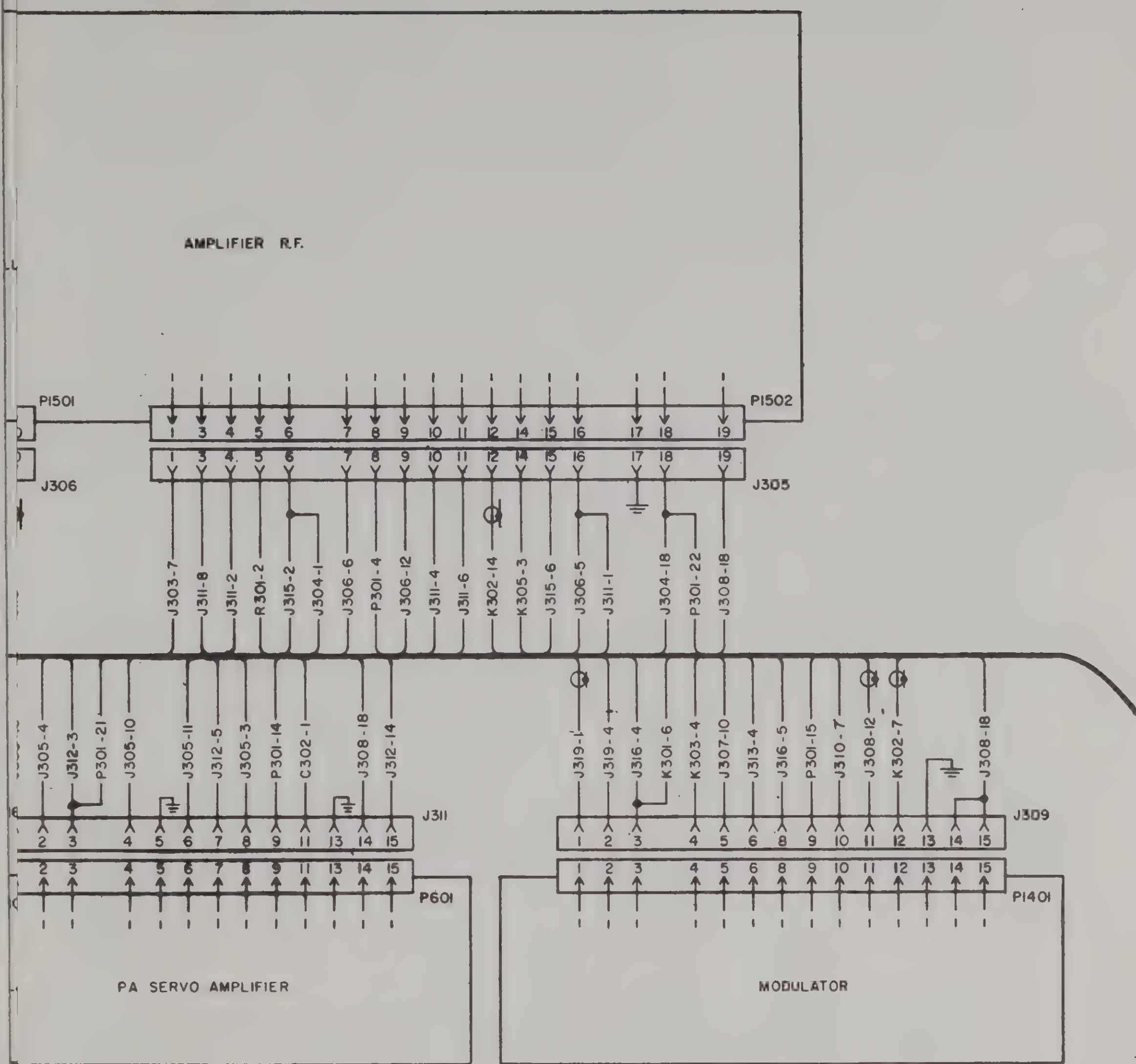


Figure 7–124. Main Chassis Schematic Diagram (Sheet 1 of 2)

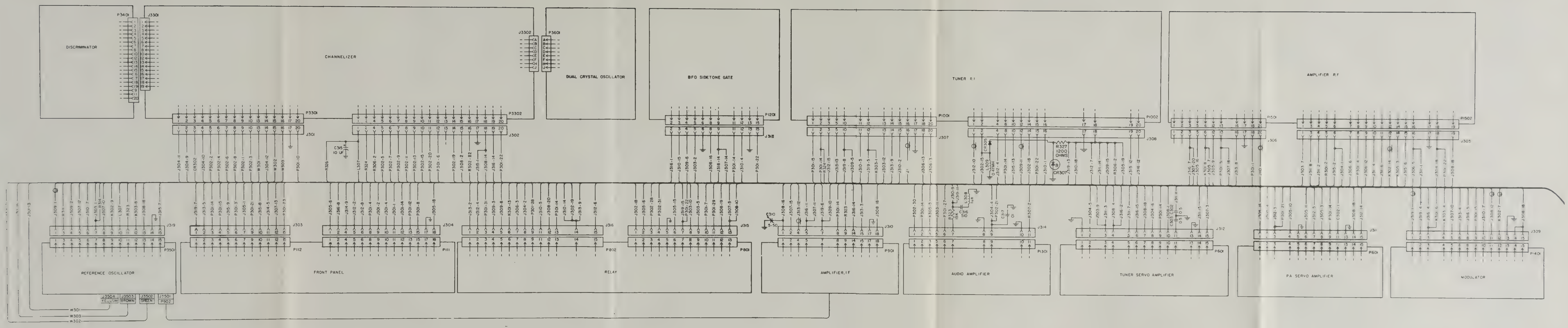


Figure 7-124. Main Chassis Schematic Diagram (Sheet 1 of 2)

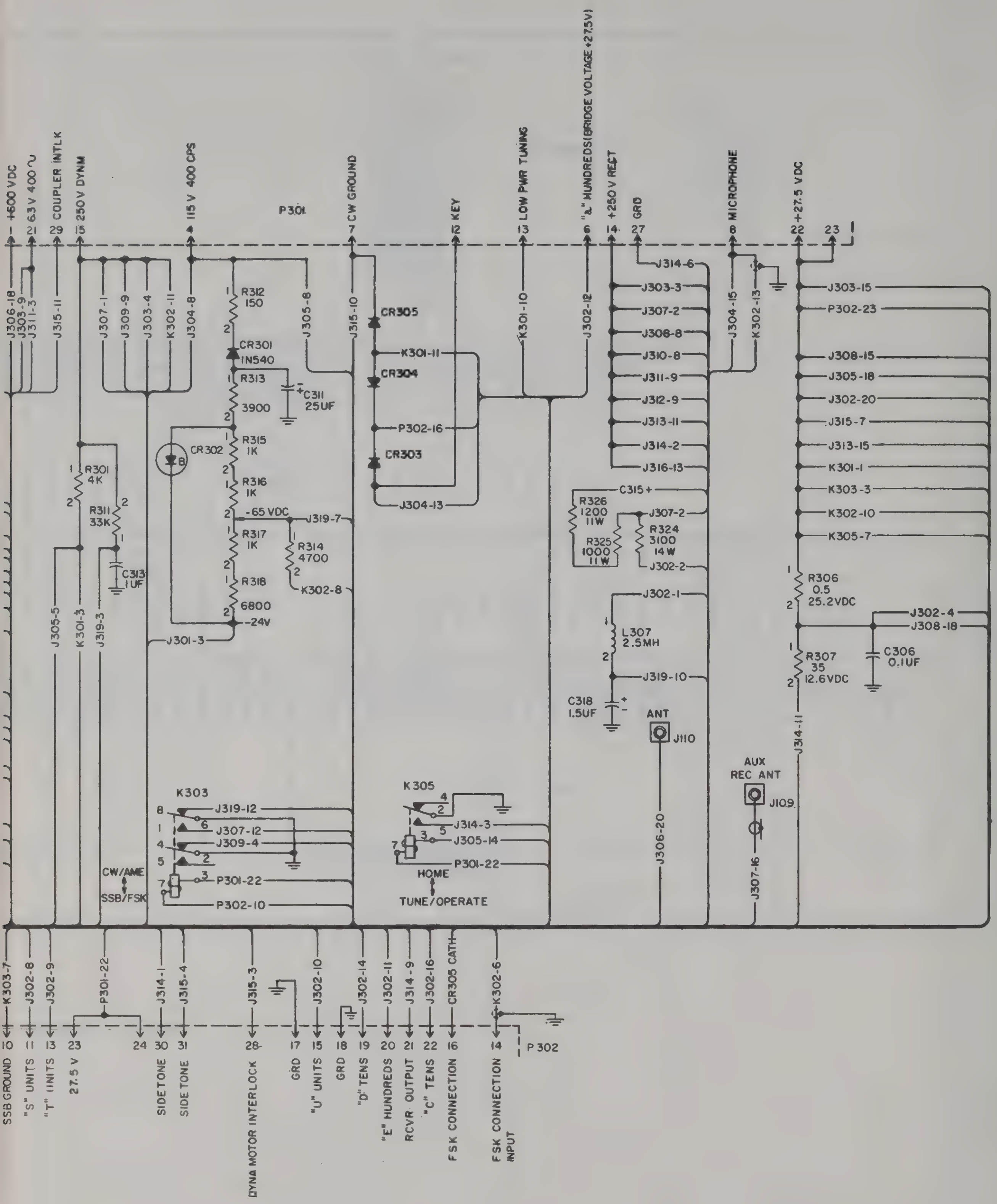
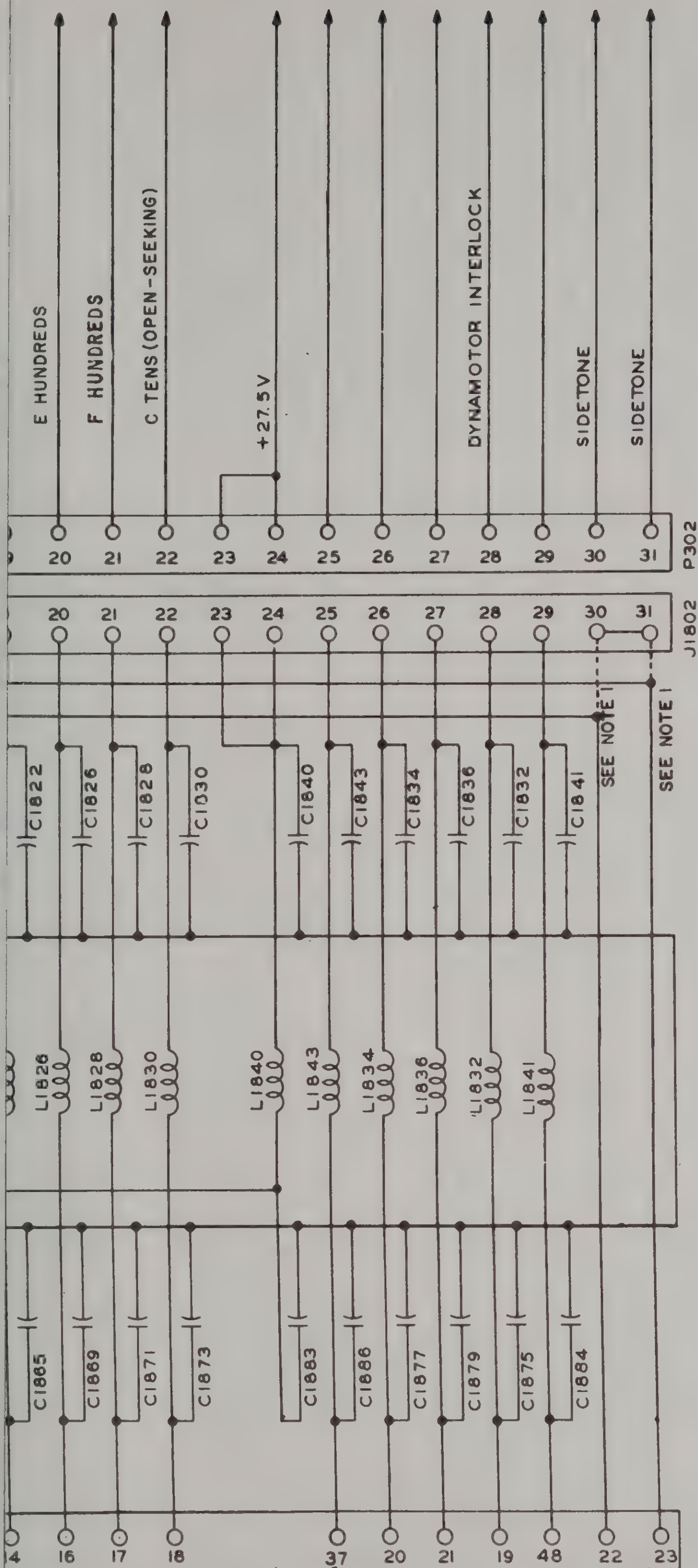


Figure 7–124. Main Chassis Schematic Diagram (Sheet 2 of 2)



NOTES:

1. THE FOLLOWING CHANGES ARE EFFECTIVE MOD 1; CAPACITORS C1803 AND C1817 REVERSED; CAPACITORS C1846 AND C1860 REVERSED; WIRE TO TERMINAL 27 OF J1801 REMOVED AND CONNECTED TO TERMINAL 25 OF J1801; TERMINALS 17 AND 18 OF J1801 JUMPERED TO TERMINAL 27 OF J1801; WIRE TO TERMINAL 30 OF J1802 REMOVED AND CONNECTED TO TERMINAL 14 OF J1802; WIRE TO TERMINAL 31 OF J1802 REMOVED AND CONNECTED TO TERMINAL 16 OF J1802; TERMINALS 30 AND 31 OF J1802 JUMPERED.

2. THE FOLLOWING CHANGES ARE EFFECTIVE MOD 2; JUMPER BETWEEN TERMINALS 17 AND 18 OF J1801 AND TERMINAL 27 OF J1801 REMOVED; WIRE TO TERMINAL 25 OF J1801 REMOVED AND CONNECTED TO TERMINAL 27 OF J1801.

3. TEST POINT 9 INCLUDES THE FOLLOWING TERMINALS OF TB1801; 2,7,11,12,21,25,40,44,45,46.

Figure 7–125. Filter Assembly Schematic Diagram

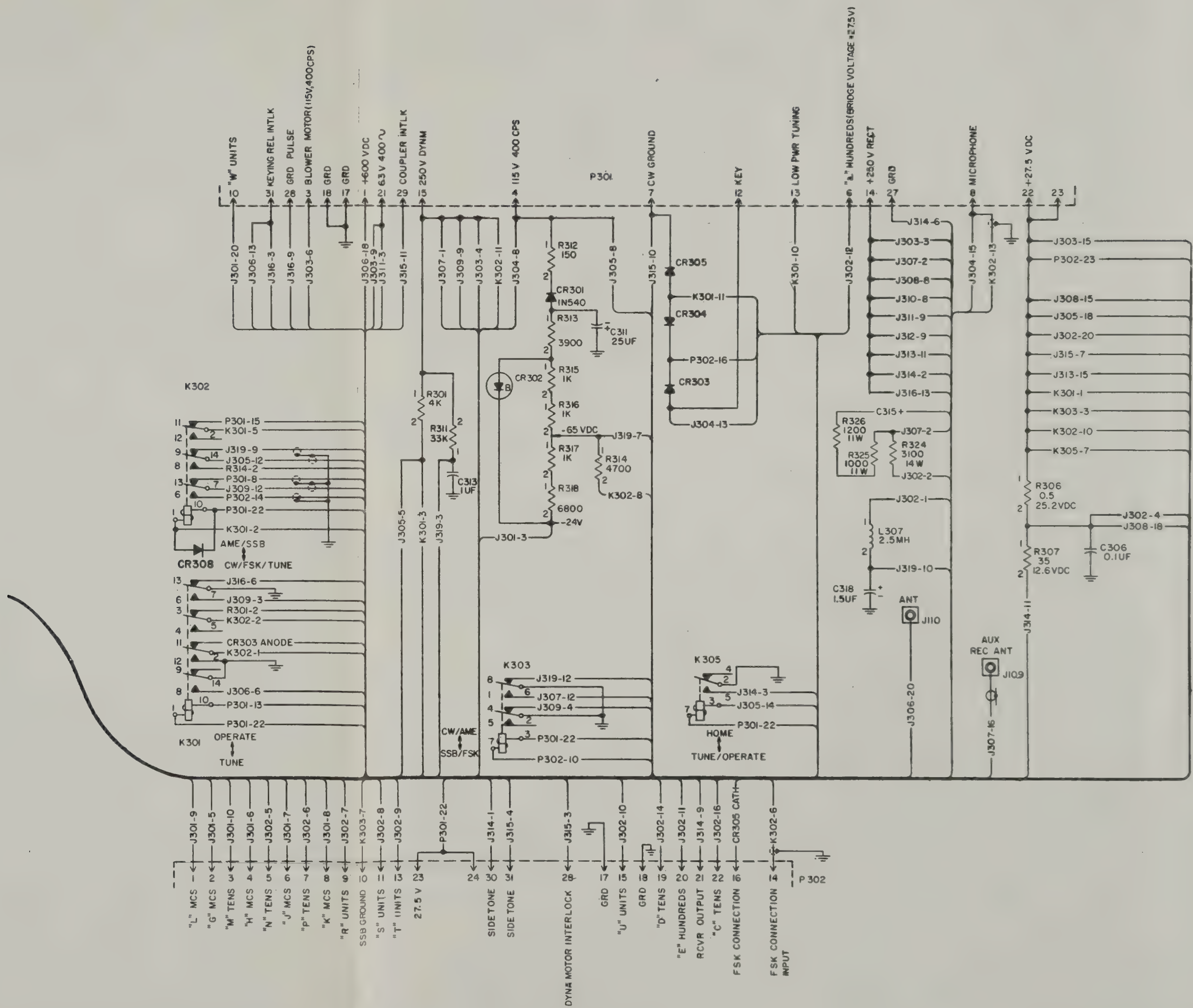
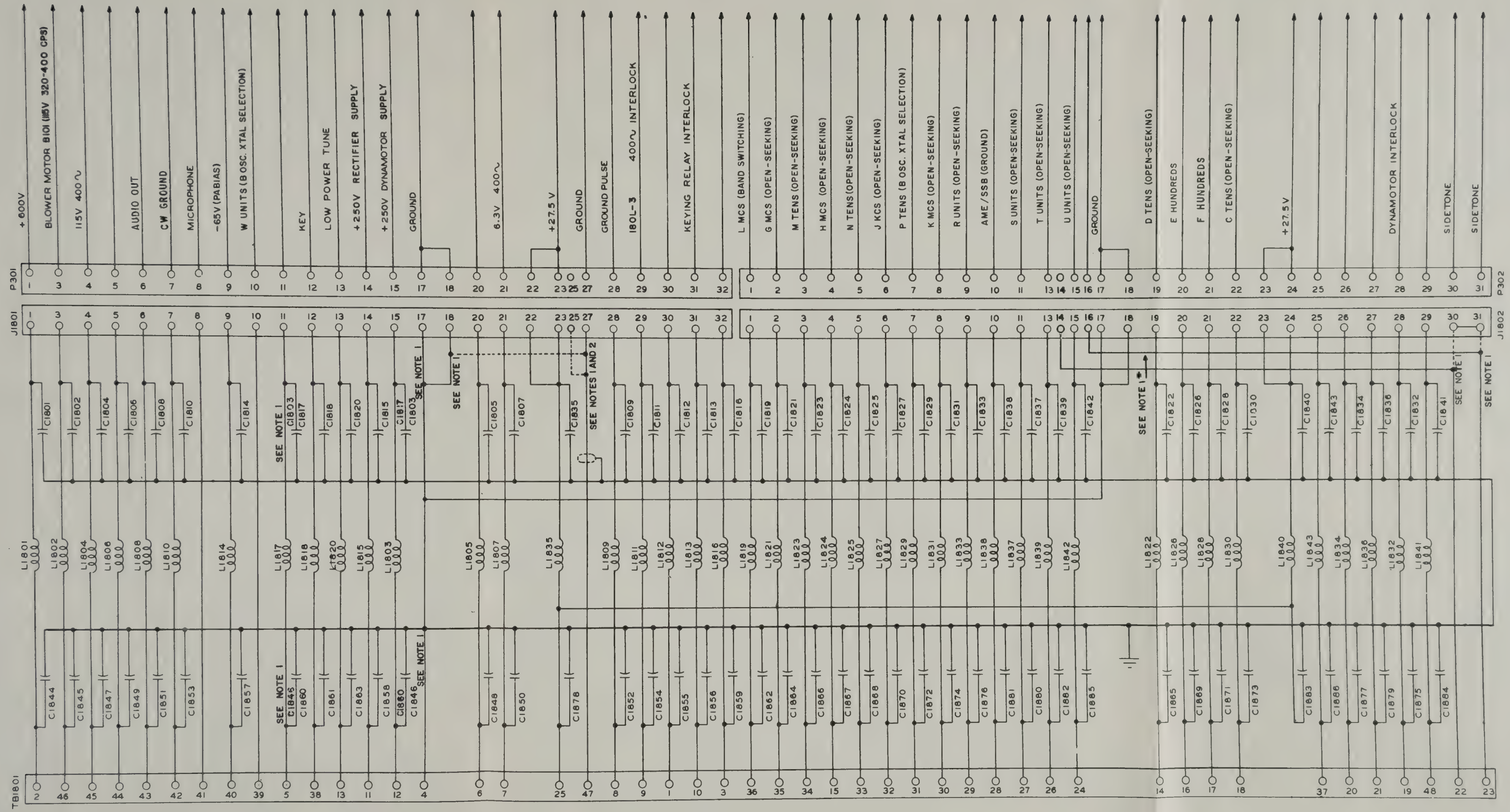


Figure 7–124. Main Chassis Schematic Diagram (Sheet 2 of 2)



NOTES:

1. THE FOLLOWING CHANGES ARE EFFECTIVE MOD 1; CAPACITORS C1803 AND C1817 REVERSED; CAPACITORS C1846 AND C1860 REVERSED; WIRE TO TERMINAL 27 OF J1801 REMOVED AND CONNECTED TO TERMINAL 25 OF J1801; TERMINALS 17 AND 18 OF J1801 JUMPERED TO TERMINAL 27 OF J1801; WIRE TO TERMINAL 30 OF J1802 REMOVED AND CONNECTED TO TERMINAL 14 OF J1802; WIRE TO TERMINAL 31 OF J1802 REMOVED AND CONNECTED TO TERMINAL 16 OF J1802; TERMINALS 30 AND 31 OF J1802 JUMPERED.

2. THE FOLLOWING CHANGES ARE EFFECTIVE MOD 2; JUMPER BETWEEN TERMINALS 17 AND 18 OF J1801 AND TERMINAL 27 OF J1801 REMOVED; WIRE TO TERMINAL 25 OF J1801 REMOVED AND CONNECTED TO TERMINAL 27 OF J1801.

3. TEST POINT 9 INCLUDES THE FOLLOWING TERMINALS OF TB1801; 2,7,11,12,21,25,40,44,45,46.

Figure 7–125. Filter Assembly Schematic Diagram

SECTION VIII

MAINTENANCE INSTRUCTIONS FOR RADIO SET CONTROL CPC-1

8-1. SCOPE OF SECTION.

8-2. This section contains instructions for trouble analysis, repair, and adjustment of a radio set control which fails to function correctly.

8-3. DIAGRAMS.

8-4. SCHEMATIC DIAGRAM. An overall schematic diagram of the radio set control is provided by figure 8-7. Figures 3-5, 4-3 through 4-6, 7-25, 7-29, 7-32, and 7-37 can be referenced if knowledge of system interconnection or operation is required.

8-5. INDEX TO DIAGRAMS. The schematic diagram of figure 8-7 and the wiring diagram shown in figure 8-8 are the only diagrams in this section.

8-6. MINIMUM PERFORMANCE STANDARDS.

8-7. After completing a repair, the radio set control should be connected in the bench test setup shown in figure 2-2 and the frequency tests outlined in paragraphs 2-9 through 2-11 performed to make certain the unit is functioning normally. Make sure the receiver-transmitter is operating normally before performing this check.

8-8. CHECK-OUT ANALYSIS.

8-9. GENERAL PROCEDURES. Reference should be made to the schematic diagram of figure 8-7 when checking this unit for a defect. As only switching circuits are involved, no trouble analysis chart has been supplied for this unit. The majority of defects encountered will be due to improperly operating switches. This type of defect can be checked with an ohmmeter by checking continuity between switch contact as outlined in figures 8-1 through 8-6.

8-10. REMOVAL AND REPLACEMENT.

8-11. Access to the parts and wiring in the unit can be accomplished by loosening the two Dzus fasteners and removing the dust cover. The volume control or a switch can only be replaced after removal of the knobs and the front panel cover plate. This can be accomplished as follows:

a. Set all channel selector switches to their "B" positions.

b. Loosen the securing screws in the control knobs with a Bristo wrench and remove the knobs.

c. Remove the two panel lights by unscrewing their caps by hand.

d. Remove the four screws securing the front panel cover plate to the assembly and remove the cover plate from the assembly.

e. Carefully note orientation of the replaced switch and switch shaft so that replacement is duplicated. This is important if proper channeling per letter code is to be accomplished after the repair.

f. Carefully unsolder all wiring to the switch. Tag each lead to assure proper replacement.

g. Loosen the hex nut securing the respective switch (or volume control) to the assembly and remove the component.

S3801 Switch Position	From J3801 Terminals to Ground (B)				
	G	H	J	K	L
B	O	O	O	C	C
C	O	O	C	O	C
D	O	C	O	C	C
F	C	O	C	O	C
G	O	C	O	O	C
H	C	O	O	C	C
J	O	O	C	C	C
K	O	C	C	O	C
L	C	C	O	O	C
M	C	O	O	O	C
N	O	O	O	C	O
P	O	O	C	O	O
R	O	C	O	C	O
S	C	O	C	O	O
T	O	C	O	O	O
V	C	O	O	C	O
W	O	O	C	C	O
X	O	C	C	O	O
Y	C	C	O	O	O
Z	C	O	O	O	O

O = Open
C = Continuity

Figure 8-1. Thousands Select Switch Test

h. If the function switch is to be replaced, perform steps a through f and then remove the two securing machine screws, lockwashers, and nuts.

i. Replace the respective part by reversing the foregoing procedures, using care (in the case of channel selector switches) to orient the unit exactly as noted in step e.

j. Solder all wiring to the replaced part as noted on the tags in step f.

k. Replace the front panel cover plate making certain all four dials are at the "B" positions.

l. Replace the four front panel securing screws, knobs, and panel lights.

m. Check unit for operation as described in paragraph 8–6.

8–12. ALINEMENT AND ADJUSTMENT.

8–13. No alinement or adjustment other than those stated in the removal and replacement procedures, is required.

8–14. LUBRICATION.

8–15. No lubrication is required.

8–16. DETAILED CIRCUIT ANALYSIS.

8–17. As the switching circuits in this unit are an integral part of the control circuits, reference should be made to paragraphs 4–24 and 7–74 for an explanation of the operation of the radio set control.

	S3802 Switch Positions									
	B	C	D	F	G	H	J	K	L	M
Resistance (measured between pins a and E of P3801)	0	35	77	124	175	229	280	327	369	404

Figure 8–2. Hundreds Select Switch Test

S3803 Switch Position	First Test From J3801 Terminal to Ground (B)					Second Test From J3801 Terminals to N		
	N	D	C	M	P	D	C	M
B	O	O	O	C	C	C	C	O
C	O	O	C	C	C	C	O	O
D	O	C	C	O	C	O	O	C
F	C	C	O	O	C	C	O	O
G	C	O	O	C	C	O	O	C
H	O	O	C	O	C	C	O	C
J	O	C	O	C	C	O	C	O
K	C	O	C	O	C	O	C	O
L	O	C	O	O	C	O	C	C
M	C	O	O	O	C	O	O	O
N	O	O	O	C	O	C	C	O
P	O	O	C	C	O	C	O	O
R	O	C	C	O	O	O	O	C
S	C	C	O	O	O	C	O	O
T	C	O	O	C	O	O	O	C
V	O	O	C	O	O	C	O	C
W	O	C	O	C	O	O	C	O
X	C	O	C	O	O	O	C	O
Y	O	C	O	O	O	O	C	C
Z	C	O	O	O	O	O	O	O

O = Open
C = Continuity

Figure 8–3. Tens Select Switch Tests

S3804 Switch Position	First Test From J3801 Terminals to Ground (B)					Second Test From J3801 Terminals to U		
	U	T	S	R	W	T	S	R
B	O	O	O	C	C	C	C	O
C	O	O	C	C	C	C	O	O
D	O	C	C	O	C	O	O	C
F	C	C	O	O	C	C	O	O
G	C	O	O	C	C	O	O	C
H	O	O	C	O	C	C	O	C
J	O	C	O	C	C	O	C	O
K	C	O	C	O	C	O	C	O
L	O	C	O	O	C	O	C	C
M	C	O	O	O	C	O	O	O
N	O	O	O	C	O	C	C	O
P	O	O	C	C	O	C	O	O
R	O	C	C	O	O	O	O	C
S	C	C	O	O	O	C	O	O
T	C	O	O	C	O	O	O	C
V	O	O	C	O	O	C	O	C
W	O	C	O	C	O	O	C	O
X	C	O	C	O	O	O	C	O
Y	O	C	O	O	O	O	C	C
Z	C	O	O	O	O	O	O	O

O = Open
C = Continuity

Figure 8–4. Units Select Switch Tests

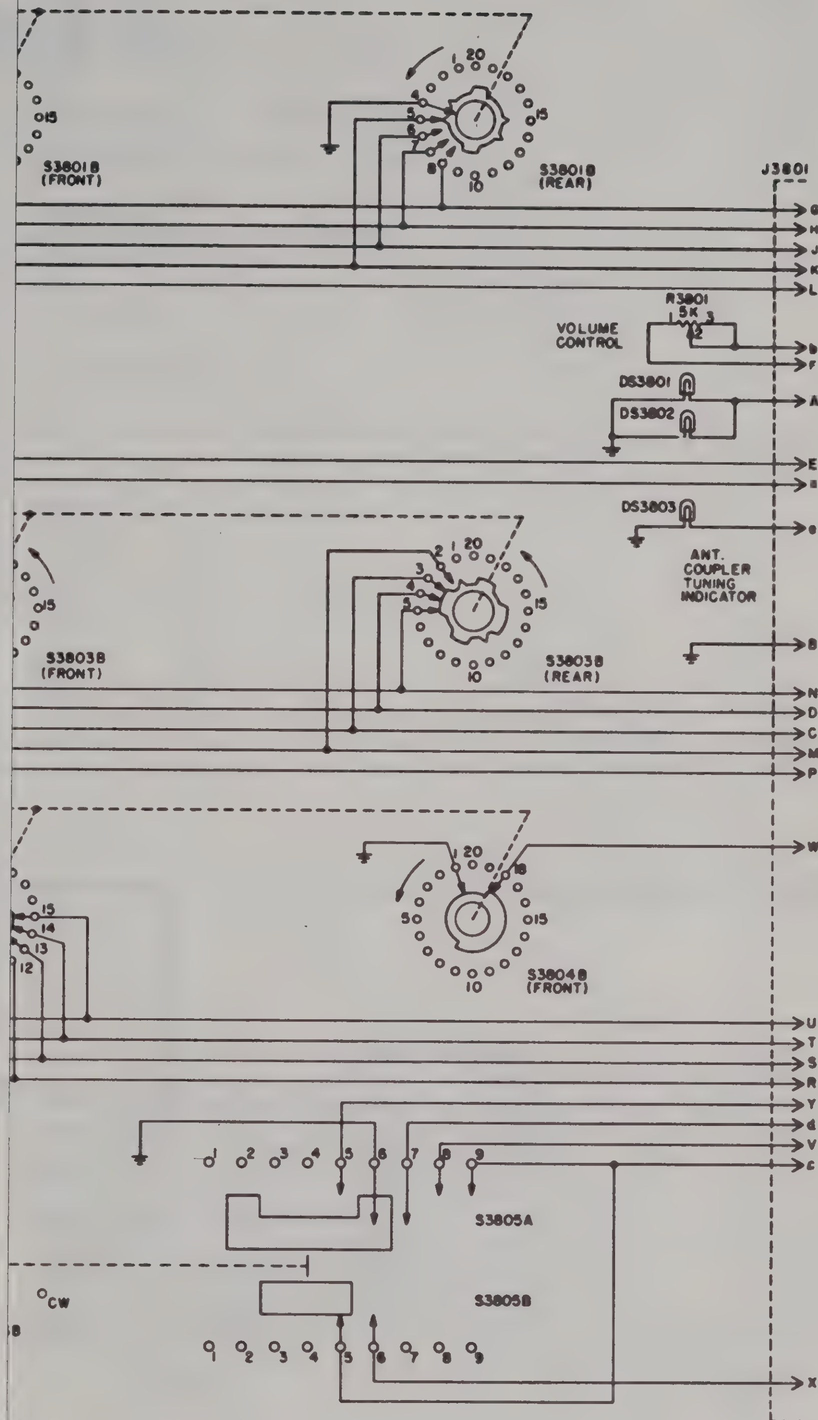
S3805 Switch Position	J3801 Terminals								Normal Indication
	From	To	From	To	From	To	From	To	
OFF	B	d	B	V	B	c	X	c	O
AME	B	d	X	c	—	—	—	—	C
SSB/FSK	B	d	X	c	B	V	—	—	C
CW	B	d					B	c	C

O = Open
C = Continuity

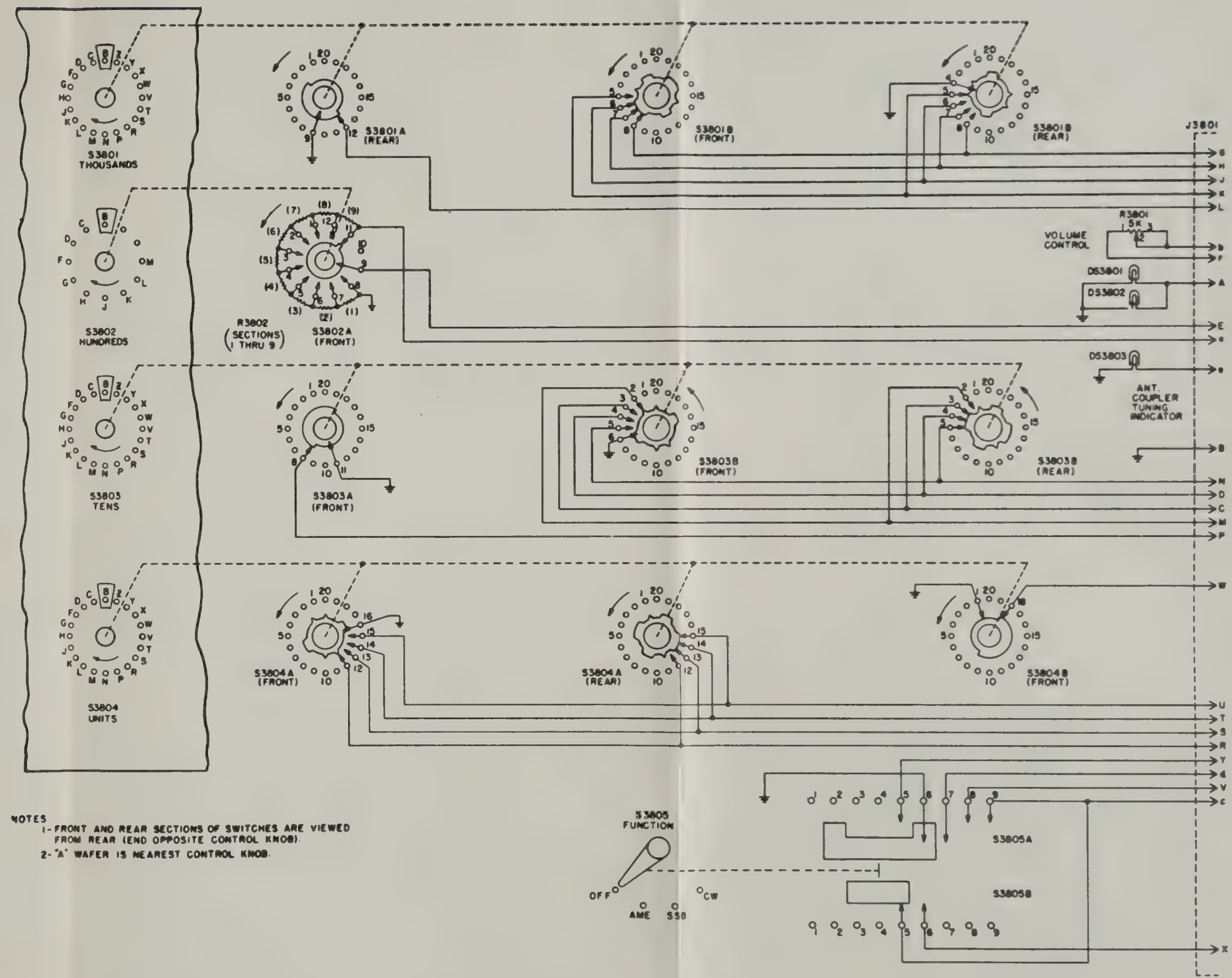
Figure 8–5. Function Switch Tests

R3801 Setting	J3801 Terminals		Meter Reading (Ohms)
	From	To	
CCW (Max.)	b	F	10,000 ± 20%
CW (Max.)	b	F	35 maximum

Figure 8–6. Volume Control Test

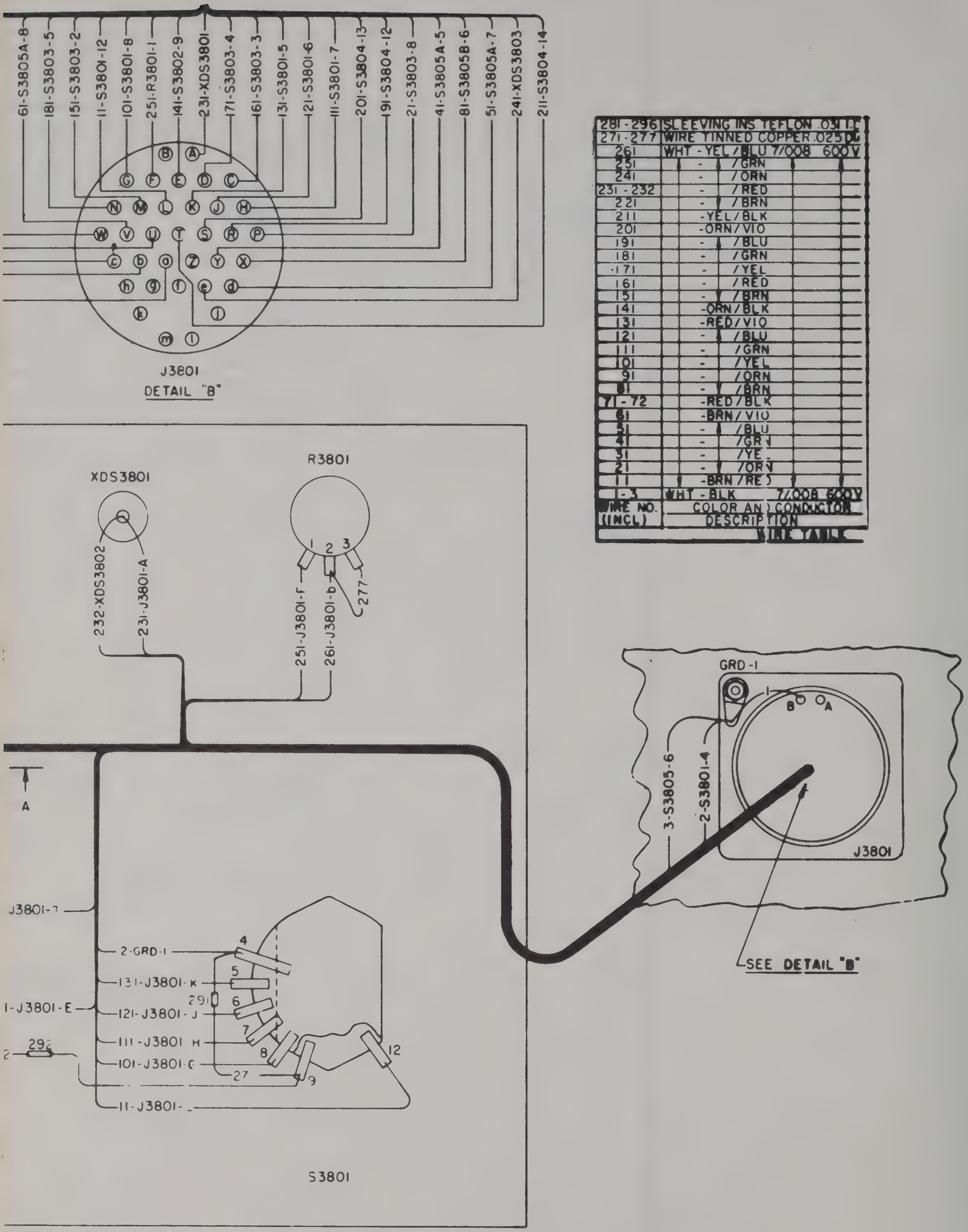


Radio Set Control CPC-1, Schematic Diagram



NOTES
1- FRONT AND REAR SECTIONS OF SWITCHES ARE VIEWED FROM REAR (END OPPOSITE CONTROL KNOB).
2- "A" WAFER IS NEAREST CONTROL KNOB.

Figure 8–7. Radio Set Control CPC–1, Schematic Diagram



WIRE NO. (INCL)	COLOR AND CONDUCTOR DESCRIPTION
281-296	SLEEVING INS. TEFLON .031 I.D.
271-277	WIRE TINNED COPPER .025 D.
261	WHT-YEL/BLU 7/008 600V
251	- /GRN
241	- /ORN
231-232	- /RED
221	- /BRN
211	-YEL/BLK
201	-ORN/VIO
191	- /BLU
181	- /GRN
171	- /YEL
161	- /RED
151	- /BRN
141	-ORN/BLK
131	-RED/VIO
121	- /BLU
111	- /GRN
101	- /YEL
91	- /ORN
81	- /BRN
71-72	-RED/BLK
61	-BRN/VIO
51	- /BLU
41	- /GRN
31	- /YEL
21	- /ORN
11	-BRN/RED
1-3	WHT-BLK 7/008 600V

WIRE TABLE

Figure 8–8. Radio Set Control CPC–1, Wiring Diagram

SECTION IX
MAINTENANCE INSTRUCTIONS FOR POWER SUPPLY 416W-1

9-1. SCOPE OF SECTION.

9-2. This section contains instructions for trouble analysis, repair, and adjustment of a Power Supply 416W-1 which fails to meet minimum performance standards. All detail parts are designated with numbers in the 1600 series.

9-3. DIAGRAMS.

9-4. SCHEMATIC DIAGRAM. An overall schematic diagram of the power supply is provided by figure 9-4. Figure 3-5 can be referenced if knowledge of system interconnections is required.

9-5. INDEX TO DIAGRAMS. Figure 9-4 is the only diagram provided in this section.

9-6. MINIMUM PERFORMANCE STANDARDS.

9-7. Figure 9-1 lists the voltages to be measured at the terminal board TB1801 of a normally operating power supply. The listed voltages are to be measured with the power supply connected into a normally operating system bench test setup as described in Section III. If an abnormal voltage is measured, check the voltage at the corresponding terminal of J1601 to make certain the respective interconnecting wire in the cable is not open. Perform the following operations:

a. Operate the function switch on Radio Set Control CPC-1 to the "AME" position and allow the equipment to warm-up for at least 10 minutes.

b. After 10 minutes have elapsed, operate the function switch to "CW".

CAUTION

Do not leave the function switch in the "CW" position for more than five minutes at a time. When in the "CW" position, dynamotor D1601 runs continuously, which is desirable for these tests. However, damage may result to the components in the system if the dynamotor is permitted to run for longer than five-minute intervals. The duty cycle of the system components is five-minutes on and five minutes off.

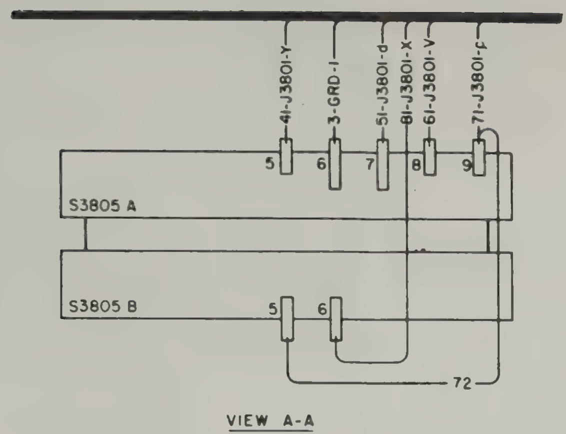
c. Connect VTVM TS-375/U between terminal listed in figure 9-1 and ground. Set the range switch on the TS-375/U for the correct a-c or d-c measurement for each listed voltage.

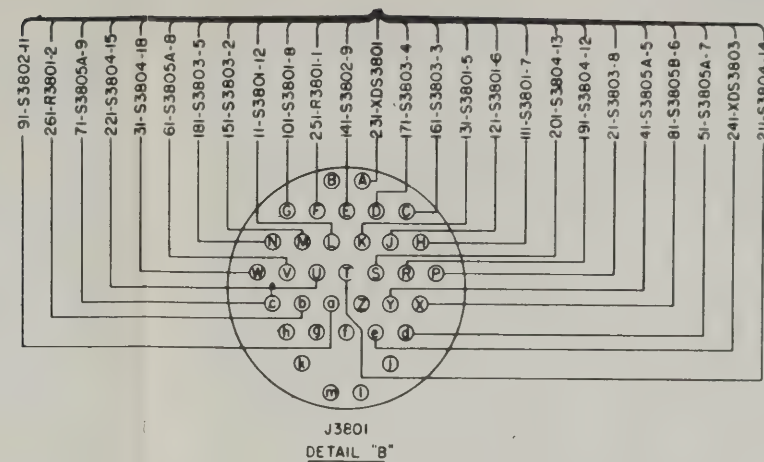
9-8. CHECK-OUT OR ANALYSIS.

9-9. GENERAL PROCEDURES. If the voltages measured in the minimum performance standards of paragraph 9-7 are all below normal, disconnect the radio set system components one at a time to make certain no one component contains an abnormal loading condition. If the abnormal voltage conditions persist, perform the check-out procedures outlined in figure 9-3.

Terminals of		Normal Voltage		Remarks
TB1801	J1601	DC	AC	
12	20	+250.0	—	Dynamotor supply voltage ouptut
40	10	−65.0	—	Rectifier bias supply (not used)
44	11	−50.0	—	Rectifier bias supply (not used)
46	13	—	115.0	Rectifier supply source voltage
7	17	—	6.3	Chopper and cw side tone voltage
45	14	—	115.0	Servo reference source voltage
11	8	+250.0	—	Rectifier supply voltage output
25	3	+27.5	—	Filament voltage (d-c) output
2	22	+600.0	—	Dynamotor supply voltage output
	18	—	18.0	L1606 output (not used)

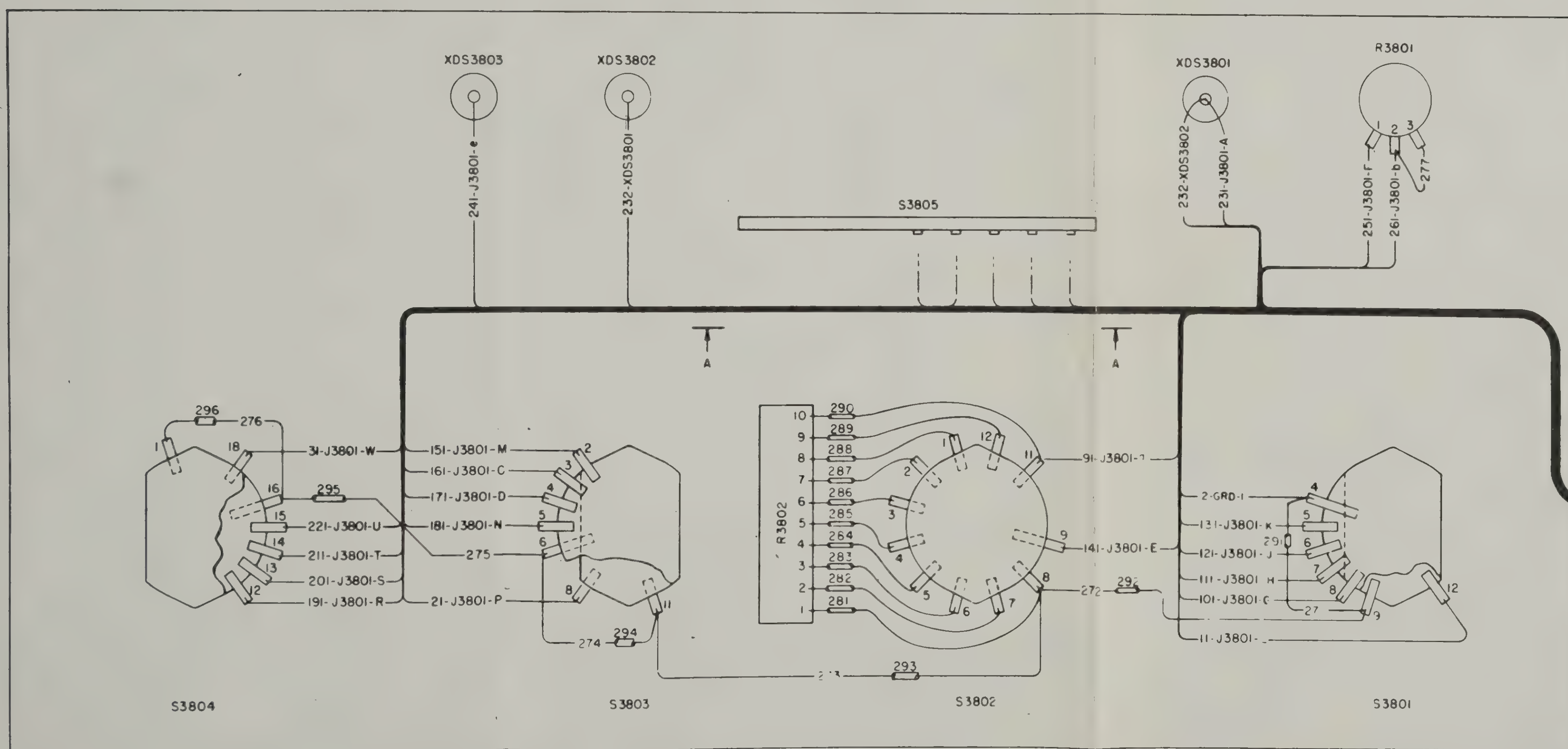
Figure 9-1. Normal Voltages for Power Supply 416W-1





WIRE TABLE

WIRE NO. (INCL)	COLOR AND CONDUCTOR DESCRIPTION
281-296	SLEEVING INS TEFLON .031 I.D.
271-277	WIRE TINNED COPPER .025 DIA
261	WHT - YEL /BLU 7/008 600V
251	- /GRN
241	- /ORN
231-232	- /RED
221	- /BRN
211	-YEL/BLK
201	-ORN/VIO
191	- /BLU
181	- /GRN
171	- /YEL
161	- /RED
151	- /BRN
141	-ORN/BLK
131	-RED/VIO
121	- /BLU
111	- /GRN
101	- /YEL
91	- /ORN
81	- /BRN
71-72	-RED/BLK
61	-BRN/VIO
51	- /BLU
41	- /GRN
31	- /YEL
21	- /ORN
11	-BRN/RED
1-3	WHT - BLK 7/008 600V



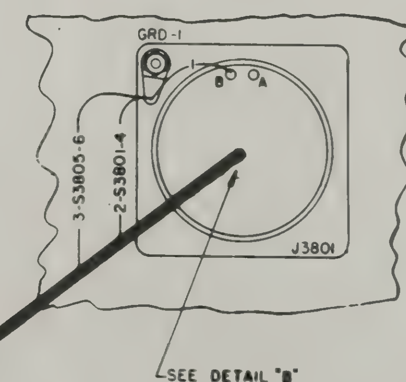


Figure 8-8. Radio Set Control CPC-1, Wiring Diagram

SECTION IX

MAINTENANCE INSTRUCTIONS FOR POWER SUPPLY 416W–1

9–1. SCOPE OF SECTION.

9–2. This section contains instructions for trouble analysis, repair, and adjustment of a Power Supply 416W–1 which fails to meet minimum performance standards. All detail parts are designated with numbers in the 1600 series.

9–3. DIAGRAMS.

9–4. SCHEMATIC DIAGRAM. An overall schematic diagram of the power supply is provided by figure 9–4. Figure 3–5 can be referenced if knowledge of system interconnections is required.

9–5. INDEX TO DIAGRAMS. Figure 9–4 is the only diagram provided in this section.

9–6. MINIMUM PERFORMANCE STANDARDS.

9–7. Figure 9–1 lists the voltages to be measured at the terminal board TB1801 of a normally operating power supply. The listed voltages are to be measured with the power supply connected into a normally operating system bench test setup as described in Section III. If an abnormal voltage is measured, check the voltage at the corresponding terminal of J1601 to make certain the respective interconnecting wire in the cable is not open. Perform the following operations:

a. Operate the function switch on Radio Set Control CPC–1 to the "AME" position and allow the equipment to warm-up for at least 10 minutes.

b. After 10 minutes have elapsed, operate the function switch to "CW".

CAUTION

Do not leave the function switch in the "CW" position for more than five minutes at a time. When in the "CW" position, dynamotor D1601 runs continuously, which is desirable for these tests. However, damage may result to the components in the system if the dynamotor is permitted to run for longer than five-minute intervals. The duty cycle of the system components is five-minutes on and five minutes off.

c. Connect VTVM TS–375/U between terminal listed in figure 9–1 and ground. Set the range switch on the TS–375/U for the correct a-c or d-c measurement for each listed voltage.

9–8. CHECK-OUT OR ANALYSIS.

9–9. GENERAL PROCEDURES. If the voltages measured in the minimum performance standards of paragraph 9–7 are all below normal, disconnect the radio set system components one at a time to make certain no one component contains an abnormal loading condition. If the abnormal voltage conditions persist, perform the check-out procedures outlined in figure 9–3.

Terminals of		Normal Voltage		Remarks
TB1801	J1601	DC	AC	
12	20	+250.0	—	Dynamotor supply voltage ouptut
40	10	−65.0	—	Rectifier bias supply (not used)
44	11	−50.0	—	Rectifier bias supply (not used)
46	13	—	115.0	Rectifier supply source voltage
7	17	—	6.3	Chopper and cw side tone voltage
45	14	—	115.0	Servo reference source voltage
11	8	+250.0	—	Rectifier supply voltage output
25	3	+27.5	—	Filament voltage (d-c) output
2	22	+600.0	—	Dynamotor supply voltage output
	18	—	18.0	L1606 output (not used)

Figure 9–1. Normal Voltages for Power Supply 416W–1

Figure 9–2 lists the normal resistance measurements for the transformer and inductors used in the power supply. If any of these components are suspected of being open or shorted, compare their resistance measurements with those listed in the table.

Symbol No.	Terminals	D-C Resistance (ohms)
L1601, L1602	1–2	10
L1604	1–2	11
L1605	1–2	4
T1601	1–2	120
	3–4, 4–5	4

Figure 9–2. Normal Resistance Measurements for Power Supply Inductors

9–10. DYNAMOTOR CHECKOUT PROCEDURES. When trouble is experienced because of a defective dynamotor, a visual inspection should be made of the unit. A dynamotor that is overheating should be checked for damaged or dry bearings, shims causing "end loading" of the bearings, a bent shaft, or sticking brushes. A noisy dynamotor should be checked for dry bearings, bent shaft, high commutator bar, and insecure mounting. No or low voltage output could be caused by a dirty commutator, low input voltage, shims "end loading" the bearings, a defective armature, or broken sticking brushes. Blown fuses may be traced to defective resistors and capacitors between voltage carrying lines and ground, or shorted turns in T1601 and L1606.

9–11. TROUBLE ANALYSIS. Figure 9–3 must be used in conjunction with the schematic diagram in order to check for a defective detail part in the power supply. The test point column of figure 9–3 lists the test points shown on figure 9–4. In order to perform these tests, the bottom plate of the power supply must be removed and measurements made at the indicated test points.

WARNING

The voltages provided by the power supply are dangerously high and could be fatal if physical contact is made. Therefore, it is absolutely necessary for maintenance personnel to avoid contact with all detail parts in the power supply when power is on.

9–12. REMOVAL AND REPLACEMENT.

9–13. REMOVAL. The Power Supply 416W–1 should be inspected at least every 120 hours of operation to assure optimum performance. This inspection should include a thorough inspection of all mechanical and electrical parts within the component. Removal of the power supply from the aircraft and preparatory steps to be taken for inspection are as follows:

a. Disconnect all cables connected to the unit.

b. Loosen the knurled fasteners or wing nuts and pull the unit forward out of its mounting.

c. Remove the four screws securing the bottom plate to the unit and remove the plate.

d. Remove dust from the inside and outside of the component with a jet of clean, dry air.

9–14. INSPECTION OF POWER SUPPLY. Proceed as follows:

a. Examine resistors, capacitors, wiring insulation, and cabling for evidence of overheating and cracking. Repair or replace as required.

b. Check wiring and terminal points for loose connections. Repair as required.

c. Unfasten and remove end bell covers of dynamotor D1601.

d. Remove dirt and dust from the dynamotor and end bell covers, using clean, dry air or a soft cloth.

e. Remove and inspect dynamotor brushes, being extremely careful not to nick or mark the edges of the brushes. Note the position and location from which each brush is removed so it can be replaced in the same position.

f. Check dynamotor commutators for excessive wear, dirt, or other defects. A highly polished commutator is desirable. However, a dark-colored commutator surface should not be mistaken for one which is burned. If the surface of the commutator is dirty, clean with a lint-free cloth moistened in approved solution and wipe dry. If the commutator is grooved, replace the dynamotor. Avoid finger marks on the commutator:

g. Secure dynamotor brushes in their holders, making certain they are replaced in exactly the same position from which they were removed.

Note

Replace brushes which are worn to approximately one-quarter inch or less. Check each new brush in its holder to see that it can move freely without being excessively loose.

h. Check dynamotor bearings to see that they are properly lubricated. If grease is needed, pack one third of ball race with MIL–G–3278 grease.

i. Reassemble the component and perform the minimum performance checks outlined in paragraph 9–6 to make certain the power supply is functioning normally.

9–15. LUBRICATION.

9–16. The dynamotor bearings are to be checked for lubrication at least every 120 hours of operation. When required, pack one third of each ball race with MIL–G–3278 grease. Always remove all hard packed or dirty lubricant before applying the fresh grease.

Step	Test Point	Test Equipment	Control Settings and Instructions	Normal Indication	If Indication Is Abnormal
1	Z1	VTVM TS-375/U	Function switch on Radio Set Control CPC-1 set to "AME" position for 10 minutes and then to "CW" position for tests. Observe caution in previous paragraph while performing all of these tests.	+27.5 VDC	Check 27.5-volt power source connections, P1601 connections, K1602 and S1602 contact closure, and C1615 quality. Replace or repair as required.
2	Z2	Same as step 1	Same as step 1	6.3 VAC	Check 115-VAC power source connections, P1603 contact closure, T1601 and F1602 quality, and R1606 value. Replace or repair as required.
3	Z3	Same as step 1	Same as step 1	115 VAC	Check 115-VAC power source connections, K1603 for contact closure, and F1602 for quality. Replace or repair as required.
4	Z4	Same as step 1	Same as step 1	−65 VDC	Check P1601 connections, K1603 for contact closure, F1601 and CR1602 for quality, and R1603 and R1604 for value.
5	Z5	Same as step 1	Same as step 1	−50 VDC	Check P1601 connections, K1603 for contact closure, F1601 and CR1602 for quality, and R1608 and R1609 for value.
6	Z6	Same as step 1	Same as step 1	+250 VDC	Check 115-VAC power source connections, P1601 connections, K1603 for contact closure, C1601A, C1601B, CR1601, CR1603, F1601, and L1602 for quality, and R1601 for value.
7	Z7	Same as step 1	Same as step 1	115 VAC	Check 115-VAC power source connections, P1601 connections, K1603 for contact closure, and F1601 for quality.
8	Z8	Same as step 1	Same as step 1	+250 VDC	Check dynamotor D1601 for proper operation, K1601, K1603, K1604, and S1601 for contact closure, L1601, L1603, and L1604 for quality, and operation of the −50-volt bias supply.
9	Z9	Same as step 1	Same as step 1	+600 VDC	Check dynamotor D1601 for proper operation, K1601, K1603, K1604 and S1601 for contact closure, L1603 and L1605 for quality, and operation of the −50-volt bias supply.

Figure 9–3. Trouble Analysis Chart for Power Supply 416W–1

9–17. DETAILED CIRCUIT ANALYSIS

9–18. CIRCUIT THEORY. Primary power for the dynamotor is applied through terminal 23 of P1601, through relays K1602 and K1603 to ground in the radio set control as shown in figure 9–4. When the function switch, S3805, in the radio set control is operated to any position (except "OFF"), relays K1602 and K1603 are energized, which allows the selenium rectifier circuits of the power supply to operate.

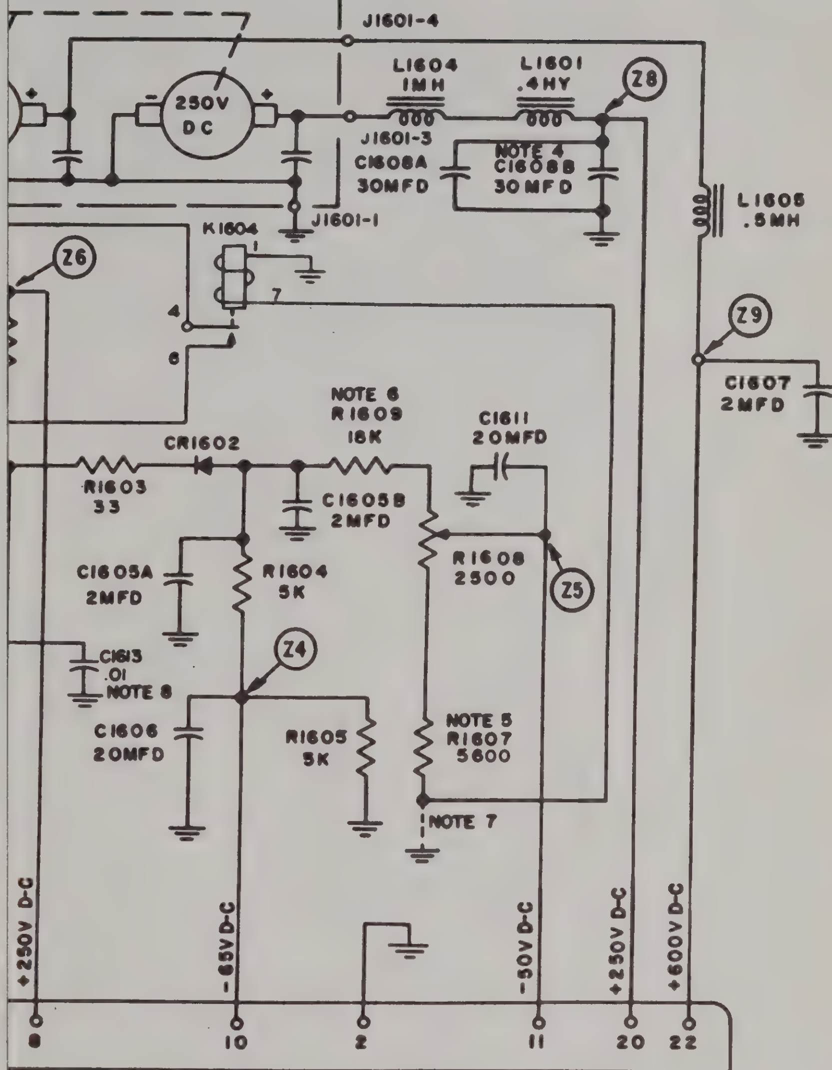
9–19. Energizing of relay K1603 results in all of the 400-cps voltages being applied to plug P1601 for distribution throughout the system. Transformer T1601 steps the 115 volts down to 6.3 volts and autotransformer L1606 steps the 115 volts down to 18 volts. Resistor R1606 and capacitor C1612 from a phase shift network for transformer T1601. The phase of the 6.3–volt 400–cps power must be correct for proper operation of the chopper coils used in the tuner and pa servo amplifier subassemblies.

9–20. After relay K1603 has been energized, a circuit exists through the surge current limiting resistor (R1601) to the 250–volt selenium rectifier supply. Parallel capacitors C1601A and C1601B form the charging capacitor required for the voltage-doubling connection of CR1601 and CR1603. On the negative alternation of the 400–cps input, C1601A and C1601B conduct through CR1601, driving the left side of C1601A and C1601B negative. On the positive alternation, the discharge path for C1601A and C1601B is through R1601, contacts on R1603, the 115–volt, 400–cps power source, and capacitors C1602A and C1603. The discharge current of C1601A and C1601B adds to the current of the 400–cps supply on the positive alternation, resulting in capacitor C1602A becoming charged to twice the peak value of the 115-volt positive alternation. On the following negative alternation, capacitor C1602A cannot fully discharge because of the long time constant formed by L1602, C1602B, and R1602, and remains at practically a constant d-c voltage. In this manner, with the discharge current of C1601A and C1601B adding to the source current to charge C1602A, and with C1602A remaining charged on the following alternation, the d-c voltage across C1602A is proportional to twice the peak of the input signal. Output from the 250–volt selenium rectifier supply is taken across bleeder resistor R1602 and applied to terminal 8 of P1601 for use throughout the system.

9–21.The 115–volt, 400–cps power also is applied through surge current limiting resistor R1603 after K1603 has been energized. The 400–cps voltage is rectified by CR1602 and filtered by the low-pass filter arrangement of C1605A, C1606, R1604, and R1605, producing a negative voltage of 65–volts d-c. The output of this supply is connected to terminal 10 of P1601. The rectified voltage from CR1602 also is applied through the filter arrangement of C1605B, C1611, R1608, and R1609 to provide a negative 50–volt bias. The negative 50–volt bias is made slightly variable by potentiometer R1608, and can be set within a limited range for the desired output voltage. The two bias supplies are not used in this system except as necessary to energize K1604. After the bias supplies are energized, a current path exists through R1607 and K1604 to ground, thereby energizing K1604.

9–22. Dynamotor D1601, in conjunction with the associated filter circuits, supplies 250– and 600–volts d-c to the system. Before primary power is available to run dynamotor D1601, relays K1601, K1602, K1603, and K1604 must be energized and sequence relay, K801, located in the relay subassembly, must be deenergized. Relays K1602 and K1603 are energized if S1602 is closed and the function switch on the radio set control is set to any "on" position. Relay K1604 is energized after the 50-volt bias supply is functioning. Sequence relay K801 is deenergized following the channelling cycle. After relays K1602, K1603, K1604, have been energized, and sequence relay K801 has been deenergized, 27.5-volts d-c is available at the field winding of K1601. The opposite side of the field winding obtains ground through contacts of switch S3805A within the radio set control, or through the microphone push-to-talk button, depending upon the mode of operation. When the function switch on the radio set control is set to the "AME" or "SSB/FSK" positions, ground is supplied for K1601 through the contacts of the microphone push-to-talk button. When in the "CW" position, ground is supplied continuously through contacts on the function switch, S3805A.

9–23. After relay K1601 has been energized, primary power is available through contacts of K1601 and through the input filter consisting of C1603, C1604, and L1603, for the low-voltage field winding of the dynamotor, D1601. The 27.5 volts is stepped-up by D1601 to 250 and 600 volts d-c. The 250–volt output is filtered by C1608A, C1608B, L1601, and L1604, and connected to terminal 20 of P1601. The 250 volts from D1601 is used as the plate supply for tubes within the antenna tuner and receiver-transmitter. The 600–volt output is filtered by L1605 and C1607 and connected to terminal 22 of P1601. The 600–volt output is used as the plate supply for the power amplifier tubes.



Power Supply 416W–1, Schematic Diagram

9–17. DETAILED CIRCUIT ANALYSIS

9–18. CIRCUIT THEORY. Primary power for the dynamotor is applied through terminal 23 of P1601, through relays K1602 and K1603 to ground in the radio set control as shown in figure 9–4. When the function switch, S3805, in the radio set control is operated to any position (except "OFF"), relays K1602 and K1603 are energized, which allows the selenium rectifier circuits of the power supply to operate.

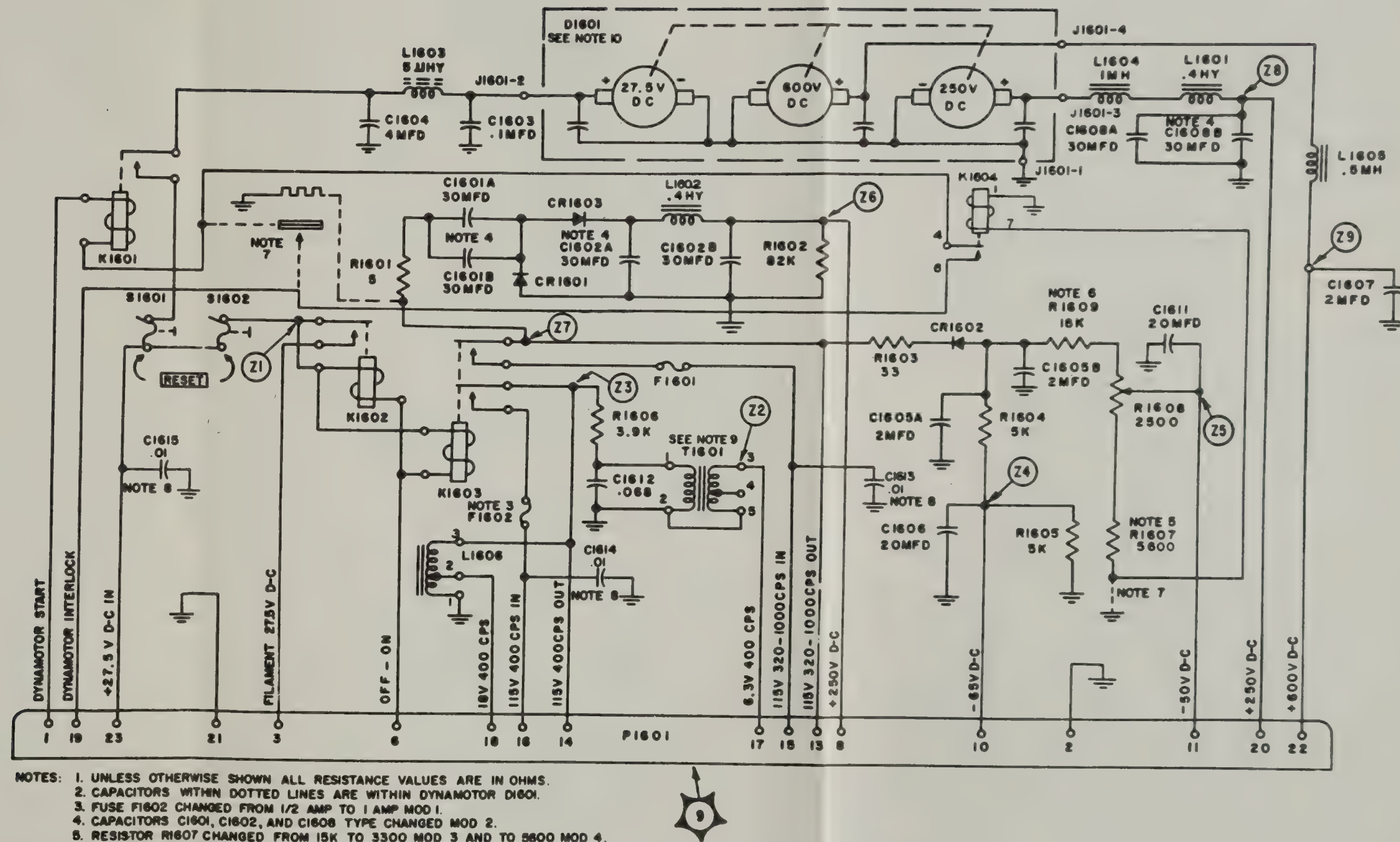
9–19. Energizing of relay K1603 results in all of the 400-cps voltages being applied to plug P1601 for distribution throughout the system. Transformer T1601 steps the 115 volts down to 6.3 volts and autotransformer L1606 steps the 115 volts down to 18 volts. Resistor R1606 and capacitor C1612 from a phase shift network for transformer T1601. The phase of the 6.3–volt 400–cps power must be correct for proper operation of the chopper coils used in the tuner and pa servo amplifier subassemblies.

9–20. After relay K1603 has been energized, a circuit exists through the surge current limiting resistor (R1601) to the 250–volt selenium rectifier supply. Parallel capacitors C1601A and C1601B form the charging capacitor required for the voltage-doubling connection of CR1601 and CR1603. On the negative alternation of the 400–cps input, C1601A and C1601B conduct through CR1601, driving the left side of C1601A and C1601B negative. On the positive alternation, the discharge path for C1601A and C1601B is through R1601, contacts on R1603, the 115–volt, 400–cps power source, and capacitors C1602A and C1603. The discharge current of C1601A and C1601B adds to the current of the 400–cps supply on the positive alternation, resulting in capacitor C1602A becoming charged to twice the peak value of the 115-volt positive alternation. On the following negative alternation, capacitor C1602A cannot fully discharge because of the long time constant formed by L1602, C1602B, and R1602, and remains at practically a constant d-c voltage. In this manner, with the discharge current of C1601A and C1601B adding to the source current to charge C1602A, and with C1602A remaining charged on the following alternation, the d-c voltage across C1602A is proportional to twice the peak of the input signal. Output from the 250–volt selenium rectifier supply is taken across bleeder resistor R1602 and applied to terminal 8 of P1601 for use throughout the system.

9–21.The 115–volt, 400–cps power also is applied through surge current limiting resistor R1603 after K1603 has been energized. The 400–cps voltage is rectified by CR1602 and filtered by the low-pass filter arrangement of C1605A, C1606, R1604, and R1605, producing a negative voltage of 65–volts d-c. The output of this supply is connected to terminal 10 of P1601. The rectified voltage from CR1602 also is applied through the filter arrangement of C1605B, C1611, R1608, and R1609 to provide a negative 50–volt bias. The negative 50–volt bias is made slightly variable by potentiometer R1608, and can be set within a limited range for the desired output voltage. The two bias supplies are not used in this system except as necessary to energize K1604. After the bias supplies are energized, a current path exists through R1607 and K1604 to ground, thereby energizing K1604.

9–22. Dynamotor D1601, in conjunction with the associated filter circuits, supplies 250– and 600–volts d-c to the system. Before primary power is available to run dynamotor D1601, relays K1601, K1602, K1603, and K1604 must be energized and sequence relay, K801, located in the relay subassembly, must be deenergized. Relays K1602 and K1603 are energized if S1602 is closed and the function switch on the radio set control is set to any "on" position. Relay K1604 is energized after the 50-volt bias supply is functioning. Sequence relay K801 is deenergized following the channelling cycle. After relays K1602, K1603, K1604, have been energized, and sequence relay K801 has been deenergized, 27.5-volts d-c is available at the field winding of K1601. The opposite side of the field winding obtains ground through contacts of switch S3805A within the radio set control, or through the microphone push-to-talk button, depending upon the mode of operation. When the function switch on the radio set control is set to the "AME" or "SSB/FSK" positions, ground is supplied for K1601 through the contacts of the microphone push-to-talk button. When in the "CW" position, ground is supplied continuously through contacts on the function switch, S3805A.

9–23. After relay K1601 has been energized, primary power is available through contacts of K1601 and through the input filter consisting of C1603, C1604, and L1603, for the low-voltage field winding of the dynamotor, D1601. The 27.5 volts is stepped-up by D1601 to 250 and 600 volts d-c. The 250–volt output is filtered by C1608A, C1608B, L1601, and L1604, and connected to terminal 20 of P1601. The 250 volts from D1601 is used as the plate supply for tubes within the antenna tuner and receiver-transmitter. The 600–volt output is filtered by L1605 and C1607 and connected to terminal 22 of P1601. The 600–volt output is used as the plate supply for the power amplifier tubes.



NOTES:
1. UNLESS OTHERWISE SHOWN ALL RESISTANCE VALUES ARE IN OHMS.
2. CAPACITORS WITHIN DOTTED LINES ARE WITHIN DYNAMOTOR D1601.
3. FUSE F1602 CHANGED FROM 1/2 AMP TO 1 AMP MOD 1.
4. CAPACITORS C1601, C1602, AND C1608 TYPE CHANGED MOD 2.
5. RESISTOR R1607 CHANGED FROM 15K TO 3300 MOD 3 AND TO 5600 MOD 4.
6. VALUE OF R1609 CHANGED FROM 22K TO 18K MOD 3.
7. RELAY K1604 CHANGED MOD 3. OLD CIRCUIT SHOWN WITH DOTTED LINES.
8. CAPACITORS C1613, C1614, AND C1615 ADDED MOD 5 AND MOD 6.
9. TRANSFORMER T1601 CHANGED TYPE MOD 7.
10. DYNAMOTOR D1601 CHANGED TYPE MOD 8.

Figure 9-4. Power Supply 416W-1, Schematic Diagram

ALPHABETICAL INDEX

Subject *Paragraph*

Subject *Paragraph*

ALPHABETICAL INDEX (Continued)

Subject — *Paragraph*

ALPHABETICAL INDEX (Continued)

ALPHABETICAL INDEX (Continued)

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